KNOWLEDGE
AN ILLUSTRATED
MAGAZINE OF SCIENCE
PLAINLY WORDED—EXACTLY DESCRIBED

*LONDON: FRIDAY, JULY 4, 1884.*

CONTENTS OF No. 140.

| | PAGE |
|---|---|
| Chemistry of Cookery. XXXVII. By W. M. Williams | 1 |
| Notes on Flying and Flying-Machines. By Richard A. Proctor | 2 |
| Electro-plating. VII. By W. Slingo | 4 |
| Comet Families of the Giant Planets. By Richard A. Proctor | 5 |
| Photographing a Flash of Lightning. (*Illus.*) | 6 |
| The Antarctic Regions By R. A. Proctor | 6 |
| International Health Exhibition.—VI. Water and Water Supplies | 7 |
| On Peculiarities of Sight and Optical Illusions. By N. E. Green | 9 |
| The Evolution of Flowers. (*Illus.*) By Grant Allen | 10 |
| Conceit (for Self and Family). By R. A. Proctor | 11 |
| Reviews | 12 |
| Editorial Gossip | 13 |
| The Face of the Sky. By F.R.A.S. | 14 |
| Correspondence | 14 |
| Our Paradox Column | 17 |
| Our Mathematical Column | 18 |
| Our Whist Column | 19 |
| Our Chess Column | 20 |

# THE CHEMISTRY OF COOKERY.

BY W. MATTIEU WILLIAMS.

## XXXVII.—COUNT RUMFORD AND THE BAVARIAN BEGGARS.

I MUST not leave the subject of vegetable cookery without describing Count Rumford's achievements in feeding the paupers, rogues, and vagabonds of Munich. An account of this is the more desirable from the fact that the "soup" which formed the basis of his dietary is still misunderstood in this country, for reasons that I shall presently state.

After reorganising the Bavarian army, not only as regards military discipline, but in the feeding, clothing, education, and useful employment of the men, in order to make them good citizens as well as good soldiers, he attacked a still more difficult problem—that of removing from Bavaria the scandal and burden of the hordes of beggars and thieves which had become intolerable. He tells us that "the number of itinerant beggars of both sexes, and all ages, as well foreigners as natives, who strolled about the country in all directions, levying contributions from the industrious inhabitants, stealing and robbing, and leading a life of indolence and most shameless debauchery, was quite incredible," and, further, that "these detestable vermin swarmed everywhere, and not only their impudence and clamorous importunity were without any bounds, but they had recourse to the most diabolical acts, and most horrid crimes, in the prosecution of their infamous trade. Young children were stolen from their parents by these wretches, and their eyes put out, or their tender limbs broken and distorted, in order, by exposing them thus maimed, to excite the pity and commiseration of the public." He gives further particulars of their trading upon the misery of their own children, and their organisation to obtain alms by systematic intimidation. Previous attempts to cure the evil had failed, and the public had lost all faith in further projects, and therefore no support was to be expected for Rumford's scheme. "Aware of this," he says, "I took my measures accordingly. To convince the public that the scheme was feasible, I determined first, by a great exertion, to carry it into complete execution, and *then* to ask them to support it."

He describes the military organisation by which he distributed the army throughout the country districts to capture all the strolling provincial beggars, and how, on Jan. 1, 1790, he bagged all the beggars of Munich in less than an hour by means of a well-organised civil and military *battue*, the New Year's Day being the great festival when all the beggars went abroad to enforce their customary black-mail upon the industrious section of the population. Though very interesting, I must not enter upon these details, but cannot help stepping a little aside from my proper subject to quote his weighty words on the ethical principles upon which he proceeded. He says that "with persons of this description, it is easy to be conceived that precepts, admonitions, and punishments would be of little avail. But where precepts fail, *habits* may sometimes be successful. To make vicious and abandoned people happy, it has generally been supposed necessary, *first*, to make them virtuous. But why not reverse this order? Why not make them first *happy* and then virtuous? If happiness and virtue be *inseparable*, the end will as certainly be attained by one method as by the other; and it is most undoubtedly much easier to contribute to the happiness and comfort of persons in a state of poverty and misery than, by admonitions and punishments, to improve their morals."

He applied these principles to his miserable material with complete success, and referring to the result exclaims, "Would to God that my success might encourage others to follow my example!" Further examination of his proceedings shows that in order to follow such example, a knowledge of first principles and a determination to carry them out in bold defiance of vulgar ignorance, general prejudice, and polite sneering, is necessary.

Having captured the beggars thus cleverly, he proceeded to carry out the above stated principle, by taking them to a large building already prepared, and where "everything was done that could be devised to make them *really comfortable*." The first condition of such comfort, he maintains, is cleanliness, and his dissertation on this, though written so long ago, might be inscribed in letters of gold over the portals of our Health Exhibition of to-day.

Describing how he carried out his principles, he says of the prisoners thus captured:—"Most of them had been used to living in the most miserable hovels, in the midst of vermin and every kind of filthiness, or to sleep in the streets, and under the hedges, half naked and exposed to all the inclemencies of the seasons. A large and commodious building, fitted up in the neatest and most comfortable manner, was now provided for their reception. In this agreeable retreat they found spacious and elegant apartments, kept with the most scrupulous neatness; well warmed in winter, and well lighted; a good, warm dinner every day, *gratis*, cooked and served up with all possible attention to order and cleanliness; materials and utensils for those that were able to work; masters *gratis* for those who required instruction; the most generous pay, *in money*, for all the labour performed; and the kindest usage from every person, from the highest to the lowest, belonging to the establishment. Here in this asylum for the indigent and unfortunate no ill-usage, no harsh language is permitted. During five years that the establishment has existed, not a blow has been given to any one, not even to a child by his instructor."

This appears like the very expensive scheme of a benevolent utopian; but, to set my readers at rest on this point, I will anticipate a little by stating that, although at

first some expense was incurred, all this was finally repaid, and, at the end of six years, there remained a nett profit of 100,000 florins "after expenses of every kind, salaries, wages, repairs, &c., had been deducted."

I must not dwell upon his devices for gradually inveigling the lazy creatures into habits of industry, for he understood human nature too well to adopt the gaoler's theory, which assumes that every able-bodied man can do a day's work daily, in spite of previous habits. Rumford's patients became industrious ultimately, but were not made so at once.

This development of industry was one of the elements of financial and moral success, and the next in importance was the economy of the commissariat, which depended on Rumford's skilful cookery of the cheapest viands, rendering them digestible, nutritious, and palatable. Had he adopted the dietary of an English workhouse or an English prison, his financial success would have been impossible, and his patients would have been no better fed, nor better able to work.

The staple food was what he calls a "soup," but I find, on following out his instructions for making it, that I obtain a porridge rather than a soup. He made many experiments, and says: "I constantly found that the richness or quality of a soup depended more upon a proper choice of the ingredients, and a proper management of the fire in the combination of these ingredients, than upon the quantity of solid nutritious matter employed;—much more upon the art and skill of the cook than upon the sum laid out in the market."

Our vegetarian friends will be interested in learning that at first he used meat in the soup provided for the beggars, but gradually omitted it, and the change was unnoticed by those who ate, and no difference was observable as regards its nutritive value.

In 1790 little, or rather nothing, was known of the chemistry of food. Oxygen had been discovered only sixteen years before, and chemical analysis, as now understood, was an unknown art. In spite of this, Rumford selected as the basis of his soup just that proximate element which we now know to contain, bulk for bulk, more nutritive matter than any other that exists either in the animal or vegetable kingdom, viz., *casein*. He not only selected this, but he combined it with those other constituents of food which our highest refinements of modern practical, chemistry, and physiology have proved to be exactly what are required to supplement the casein and constitute a complete dietary. By selecting the cheapest form of casein and the cheapest sources of the other constituents, he succeeded in supplying the beggars with good hot dinners daily at the cost of one halfpenny each. The cost of the mess for the Bavarian soldiers under his command was rather more, viz., twopence daily, three farthings of this being devoted to pure luxuries, such as beer, &c. The details of the means by which he achieved these notable results will be stated in my next.

---

Apropos of the great enthusiasm at present existing on the subject of photography, and the number of distinguished amateurs who practise the art, it may interest our readers to know that among them may be included H.R.H. Duc de Chartres, who has just favoured Messrs. Watson & Sons, of 313, High Holborn, with an order for complete outfits to take pictures up to 18 by 16 inches.

The members of the Harleian Society have received during the week the "Visitation of London, 1633-4," Vol. II., edited by Dr. J. J. Howard. The "Registers of St. Antholin, Budge Row," had previously been issued to subscribers by Messrs. Mitchell & Hughes. The "Visitation of Gloucestershire in 1623," edited by Sir John Maclean and W. C. Heane, Esq., will also be ready for members this year; likewise Vol. I. of the "Registers of St. James, Clerkenwell," edited by Robert Hovenden, Esq.

## NOTES ON FLYING AND FLYING-MACHINES.

By Richard A. Proctor.

(*Continued from page* 472.)

We come next to a much more important point, namely, extent of supporting surface. We are to consider the air now, not with regard to its density, the quality which enables a balloon, filled with rarer gas, to float in air, but with reference to its power of resisting downward motion through it; that is, of resisting the effects of gravity. We have to inquire what extent of surface, spread either in the form of wings or as in parachutes, will suffice to support a man or a flying-machine. It is here that the researches recently made seem to bear most significantly upon the question of the possibility of flight.

The history of the parachute affords some insight into the supporting power of the air—some, but not much. The parachute has been commonly suffered to fall from beneath the car of a balloon. Suspended thus, in the lee, so to speak, of the balloon's mass, and with its supporting surface unexpanded, the parachute descends under highly unfavourable conditions. A great velocity of descent is acquired before the parachute is fully expanded, and thus the parachute has to resist a greater down-drawing force than would be the case if the machine were open, and surrounded on all sides by free air, at starting. The consequence is a great and sudden strain upon all parts of the parachute, as well as a degree of oscillation which seriously risks its structure, besides impairing its supporting power—since this power would obviously act most effectively if the span of the parachute remained horizontal throughout the descent. The following account of Garnerin's descent, in 1797, illustrates the foregoing remarks:—"In 1797," says Mr. Manley Hopkins, "Garnerin constructed a parachute, by which he descended from a balloon, at an elevation of 2,000 feet. The descent was perilous, for the parachute failed, for a time, to expand; and after it had opened, and the immediate fears of the immense concourse which had assembled in Paris to witness the attempt had been removed, the oscillations of the car, in which Garnerin was seated, were so violent as to threaten either to throw him out, or, on arriving at the ground, to dash him out with violence. He escaped, however!" We notice the same circumstances in the narrative of poor Cocking's disastrous attempt in 1837. "When the cords which sustained the parachute were cut, it descended with dangerous rapidity, oscillating fearfully, and at last the car broke away from the parachute, and Mr. Cocking was precipitated to the ground, from a height of about one hundred feet."

But apart from these considerations, the parachute affords no evidence whatever of the increased sustaining power of the air on bodies which traverse it rapidly in a more or less horizontal direction. The parachute descends, and descends quickly: we have to inquire whether the air may not resist descent so strongly that with comparatively small effort a horizontal or even ascending motion may be effected.

A familiar illustration of this supporting power of the atmosphere is given in the flight of an oyster-shell or piece of thin slate, deftly thrown from a schoolboy's practised hand. Such a missile, instead of following the parabolic path traversed by an ordinary projectile, is seen to skim along almost like a bird on resting pinions. It will sometimes even ascend (after the projectile force has ceased to act in raising it), as though in utter disobedience to the laws of gravitation.

The fact appears to be that when a horizontal plane traverses the air in a horizontal direction, the supporting power of the air is increased in proportion as the plane moves more quickly, or in proportion to the actual quantity of air it glides over, so to speak. Indeed, we have clear evidence to this effect in the behaviour of the common toy-kite, the supporting power of which is increased in proportion to the force of the wind. For a kite held by a string in a strong horizontal current of air, corresponds exactly to an inclined plane surface drawn swiftly in a horizontal direction during a calm. The same supporting power which results from the rapid passage of the air under the kite will be obtained during the rapid passage of the kite over still air.

When we study the flight of birds we are confirmed in the opinion that velocity of horizontal motion is a point of extreme importance as respects the power of flying. For though there are some birds which seem to rise almost straight from the ground, yet nearly all, and especially the larger and heavier birds, have to acquire a considerable horizontal velocity before they can take long flights. Even many of those birds which seem, when taking flight, to trust rather to the upward and downward motion of their wings than to swift horizontal motion, will be found, when carefully observed, to move their wings up and down in such sort as to secure a rapid forward motion. I have been much struck by the singularly rapid forward motion which pigeons acquire by what appears like a simple beating of their wings. A pigeon which is about to fly from level ground may be seen to beat its wings quickly and with great power; and yet instead of rising with each downward stroke, the bird is seen to move quite horizontally,—as though the wings acted like screw-propellers. I believe, in fact, that the wings during this action do really act, both in the upward and downward motion, in a manner resembling either screw-propulsion or the action by which seamen urge a boat forward by means of a single oar over the stern.* The action of a fish's tail is not dissimilar; and as the fish, by what seems like a simple beating of its tail from side to side, is able to dart swiftly forwards, so the bird, by what seems like a beating of its wings up and down, is able—when occasion requires—to acquire a swift forward motion. At the same time it must be understood that I am not questioning the undoubted fact that the downward beat of a bird's wing is also capable of giving an upward motion to the bird's body. The point to be specially noticed is that when a bird is taking flight from level ground, the wings are so used that the downward stroke gives no perceptible upward motion.

But since a horizontal velocity is thus effective, we might be led to infer that the larger flying creatures, which, *cæteris paribus*, travel more swiftly through the air than the smaller, would require a smaller relative extent of supporting surface. We are thus led to the consideration of that point which has always been regarded as the great, or rather the insuperable difficulty, in the way of man's attempts at flight,—his capacity or incapacity to carry the requisite extent of supporting surface. We are led to inquire whether a smaller extent of supporting surface than has hitherto been deemed necessary may not suffice in the case of a man, and *à fortiori* in the case of a large and powerful flying-machine.

The inference to which we have thus been led, is found to accord perfectly with the observations which have been made upon flying creatures of different dimensions. It has been found that the supporting surface of these creatures,—whether insects, birds, or bats,—by no means varies in proportion to their weight. This is one of the most important results to which the recent inquiries into the problem of flight have led; and I believe that my readers cannot fail to be interested by an account of the relations which have been observed to hold between the weight and the supporting surface of different winged creatures.

We owe to M. de Lucy, of Paris, the results of the first actual experiments carried out in this direction. The following account of his observations (made in the years 1868, 1869) is taken from a paper by Mr. Brearey, the Honorary Secretary to the Aëronautical Society. "M. de Lucy asserts," says Mr. Brearey, "that there is an unchangeable law, to which he has never found any exception, amongst the considerable number of birds and insects whose weights and measurements he has taken, viz., that the smaller and lighter the winged animal is, the greater is the comparative extent of supporting surface. Thus in comparing insects with one another—the gnat, which weighs 460 times less than the stag-beetle, has fourteen times greater relative surface. The ladybird, which weighs 150 times less than the stag-beetle, possesses five times more relative surface, &c. It is the same with birds. The sparrow, which weighs about ten times less than the pigeon, has twice as much relative surface. The pigeon, which weighs about eight times less than the stork, has twice as much relative surface. The sparrow, which weighs 339 times less than the Australian crane, possesses seven times more relative surface, &c. If we now compare the insects and the birds, the gradation will become even more striking. The gnat, for example, which weighs 97,000 times less than the pigeon, has forty times more relative surface; it weighs 3,000,000 times less than the crane of Australia, and possesses relatively 140 times more surface than this latter, which is the heaviest bird M. de Lucy had weighed, and was that also which had the smallest amount of surface, the weight being nearly 21 lb.; and the supporting surface 139 inches per kilogramme (2 lb. 3¼ oz). Yet of all travelling birds the Australian cranes undertake the longest and most remote journeys, and, with the exception of the eagles, elevate themselves the highest, and maintain flight the longest."

M. de Lucy does not seem to have noticed the law to which these numbers point. It is exceedingly simple, and amounts in fact merely to this, that instead of the wing-surface of a flying creature being proportioned to the weight, it should be proportioned to the surface of the body (or technically, that instead of being proportioned to the cube, it should be proportioned to the square of the linear dimensions). Thus, suppose that of two flying creatures one is 7 times as tall as the other, the proportions of their bodies being similar, then the body surface of the larger will be 49 times (or 7 times 7) that of the other, and the weight 343 times (or 7 times 7 times 7) that of the other. But instead of the extent of wing-surface being 343 times as great, it is but 49 times as great. In other words, relatively to its weight the smaller will have a wing-surface 7 times greater than that of the larger. How closely this agrees with what is observed in nature, will be seen, by the case of the sparrow as compared with the Australian crane; for M. de Lucy's experiments show that the sparrow weighs 339 times less than the Australian crane, but has a relative wing-surface 7 times greater.

It follows, in fact, from M. de Lucy's experiments, that, as we see in nature, birds of similar shape should have wings similarly proportioned, and not wings corresponding to the

* Sailors call this *sculling*, a term more commonly applied to the propulsion of a boat by a single oarsman using a pair of oars, or sculls.

relative weight of the birds. The same remark applies to insects; and we see, in fact, that the bee, the bluebottle, and the common fly—insects not unlike in their proportions—have wings proportioned to their surface dimensions; the same holding amongst long-bodied insects, like the gnat and the dragon-fly, and the same also among the different orders of flying beetles.

So that, setting apart differences of muscular capacity and adaptation, a man, in order to fly, would need wings bearing the same proportions to his body as we observe in the wings of the sparrow or the pigeon. In fact, the wings commonly assigned to angels by sculptors and painters would not be so disproportioned to the requirements of flight as has been commonly supposed, if only the muscular power of the human frame were well adapted to act upon wings so placed and shaped, and there were no actual inferiority in the power of human muscles (cross-section for cross-section) as compared with those of birds.

So far as the practicability of actual flight on man's part is concerned, these two points are, indeed, among the most important we have to consider. It was to Borelli's remarks on these points, in his famous treatise, *De motu Animatium*, that the opinion so long entertained respecting the impracticability of flight must be referred. He compared the relative dimensions of the breast muscles of birds with those of the corresponding muscles in man, and thence argued that man's frame is altogether unadapted to the use of wings. He compared also the relative muscular energy of birds and men, that is, the power of muscles of equal size in the bird and the man; and yet was further confirmed in the opinion that man can never be a flying animal.

*(To be continued.)*

## ELECTRO-PLATING.

VII.

By W. Slingo.

THE copy, on being released from the mould, is generally more or less brittle. It is, therefore, made red-hot in a clear fire or by means of a blow-pipe. When cool it is placed in a weak sulphuric acid solution to remove any scale or superficial impurities which may be present. After a few minutes' exposure it is removed into a vessel containing clean water, and subsequently taken out and dried. Any superfluous metal that still remains is now chipped off and the copy cut to form. The surface next requires polishing, which is accomplished with rotten-stone and oil, applied with a stiff brush. The particles of metal, &c., adhering to the copy are washed off with soap and boiling water, and the surface again polished, using this time moistened rouge and a soft brush. The finger, at this stage, becomes a very useful tool for brightening the smoother portions of the surface. When the copy is required to possess considerable substance, that is to say, when it is to be able to withstand rough or hard usage, as in the case of electrotypes of wood engravings, &c., a backing of foreign and more easily fusible metal is and must be provided. It would be false economy, and, indeed, almost a practical impossibility, to take copies sufficiently stout to answer such purposes as above indicated. The process of "backing" should present no serious difficulties to the amateur. The copy should be laid face downwards and the back or inner surface moistened with killed spirits of salts, that is to say, hydrochloric acid which has been neutralised or killed by dropping in it small pieces of zinc. A small piece of pewter solder is then placed on the back of the copy and made to cover that surface. This is easily accomplished with a soldering iron or (holding the copy in the jaws of a pair of pliers, so as to be able to move it about) a blowpipe flame.* For want of better means, a good flame may be obtained from a gas-jet, and sometimes from a spirit-lamp, with the aid of a piece of non-combustible tubing, such as the stem of a clay tobacco-pipe. Care must be taken that the surface of the copper is fairly coated with solder. This is ensured by an efficient application of the chloride of zinc solution. The coating of solder being obtained, lead is next poured in till the required thickness is obtained. The lead combines or adheres to the solder readily, but would not so adhere to the bare copper, hence the necessity for using the solder. Apart from the scientific or experimental interest pertaining to the various operations described, there are a vast number of practical applications fraught with the greatest importance. Not the least of these is the adaptation of the electrotyping process to printing on a large scale. Where a large number of impressions are required, more particularly of diagrams, pictorial illustrations, newspaper headings, &c., the process is almost invariably resorted to. The *Illustrated London News* and such-like papers not only treat their illustrations in this way, but apply the process to their type as well. The process is a simple one. A ball of gutta-percha is place on the centre of the type and worked outwards gradually so as to exclude every possible particle of air, and obtain a perfect negative copy of the type. A weight is placed on the percha, and left there until the latter has cooled down. When cool, the percha is well coated with plumbago, and immersed in the electrolytic bath for a few hours, when, a sufficiently thick deposit having been obtained, it is taken from the bath, the percha separated from the copper, and a substantial backing supplied. The backing being made level, it is screwed on to a wooden block, of a thickness sufficient to raise the electrotype to the same level or thickness as ordinary lead type. The advantage of such a process is evident. More especially is this so in the case of an engraving, which would manifestly suffer very considerably were it used extensively. The durability of a wood engraving is not extraordinarily great, and once damaged the cost of replacing it is almost, if not quite, as great as the original cost; whereas, by the adoption of the electrotyping process, additional equally good copies may be procured at only a trifling expense. The advantages offered by the process for the preservation of valuable and artistic engravings are too apparent to be further discussed. Some papers, it may be furthermore remarked, are very hard and unyielding, and in consequence they considerably injure the type or block, speedily rendering the impressions blurred and more or less trying to decipher. It is recorded that as many as 20,000,000 impressions have been taken from a single mould. Some typers use plaster of Paris instead of gutta-percha; but although it is cheaper and sets more rapidly, it does not yield so perfect a copy, there being a want of clearness. There is, however, one great drawback to the adoption of the electrotyping process for books, viz., that in second or subsequent editions, errors, small, it may be, in the amount of type involved, but great in importance, cannot be rectified without sacrificing a page or so of the electrotype. On the other hand, there is

* A soldering-iron in the hands of the amateur is often a dangerous weapon. He is apt to use it too heavily, and there is a possibility of his pushing it through the electrotype. A spirit flame is, therefore, safer and equally effectual.

to be considered the fact that were it not for the comparatively small expense involved in taking and warehousing electrotypes, many valuable but little saleable works could not bear the cost of a second edition.

The amateur who aspires to produce good work eventually is advised to be particular in every detail, and not to rest satisfied until every mould immersed in the bath is efficiently copied. In experimenting in electro metallurgy there is nothing to be apprehended of an unduly difficult or impracticable nature. Cleanliness is essential. Having satisfied himself with his proficiency in copying coins and such-like simple surfaces, the experimentalist may next proceed to more elaborate and more intricate work. To obtain a silvered or gilded copy of the skeleton of a leaf should not be too great a task for him ultimately, and what kind of work is there that is prettier or more interesting?

Supposing that, with the aid of the elastic mould, copies have been obtained of medals, &c., more or less undercut, let us next direct our attention to plaster casts and other similar works of art. Small and simple busts, &c., should be attempted first. An interesting experiment is to coat a small bust with copper. This is easily effected by first saturating the plaster with bee's-wax or linseed oil—the former by preference—and then applying a good coating of plumbago. Some unimportant portion of the bust has then attached to it the wire connected with the zinc pole of the battery. It is not difficult to imagine that any mould which is in deep relief, or considerably undercut, will, under ordinary circumstances, receive a very uneven deposit, that portion which lies in the immediate neighbourhood of the connecting wire receiving the lion's share. To obviate this, a few short pieces of fine wire are firmly attached to the wire from the zinc pole of the battery, and their free ends placed in the hollow and more remote parts of the mould. By this means a more equable deposit is ensured. In the present experiment of copper-plating a bust, only a very thin deposit may be permitted, otherwise there will be a considerable want of definition, the finer lines, which are essential to the character of any work of art, being lost. I have had comparatively thick deposits in which the design is somewhat faithfully depicted on both sides of the copy, but such a result can only be looked for after considerable practice. As a rule, the thinner the film, the truer will be the design.

## COMET FAMILIES OF THE GIANT PLANETS.

By RICHARD A. PROCTOR.

THERE is a family of comets every member of which travels in an orbit passing near the orbit of Jupiter; another family every member of which can be similarly associated with Saturn; others depending in the same way on Uranus; others on Neptune: and in fact, so fully has this sort of relation been recognised, that the idea has even been thrown out that a planet travelling outside the orbit of Neptune but as yet unknown might be detected by the movements of a comet intersecting the great plane of planetary movement far beyond Neptune's orbit. It may be mentioned, indeed, in passing, that the comet of 1862, which has been associated with the meteors of Aug. 10 and 11, intersects the plane of planetary movements at a place about as far beyond the orbit of Neptune as that orbit is beyond that of Uranus, and that it has been held probable that at that distance an as yet undiscovered giant planet may travel.

This remarkable relation among the orbits of the comets which travel periodically around the sun has been interpreted by supposing that all such comets were drawn in from outer space by the sun's attraction, and prevented from returning to outer space by the disturbing influence of one or other of the giant planets. If we suppose a comet, drawn sunwards past the orbit of Jupiter, to be so perturbed by the action of that planet as to lose a considerable portion of its velocity, then that comet would travel thereafter on an orbit passing close to the point on Jupiter's orbit where it had been thus perturbed in such sort as to become an attendant on the sun. But in the first place the explanation requires that the original orbit of the comet should have passed near to the orbit of Jupiter, and a little consideration will show that there should be millions of comets for each thus travelling,—a numerical relation not found to exist among the cometic systems. And secondly, while the explanation would be valid enough were a comet a solid globe or very small, it fails utterly when we recognise that a comet is a flight of bodies occupying a very large extent of space. It can be shown that supposing a comet's head to be but 10,000 miles in diameter, and formed of discrete meteoric masses, then if the comet came near enough to Jupiter for its centre to be disturbed in the way the theory requires, those meteoric masses nearest to Jupiter would be so much more disturbed as to be sent on very different orbits, while the new orbits of those masses farthest from Jupiter would be so much less disturbed that their orbits would also be entirely different. The theory that such comets have been introduced from without fails utterly in the presence of observed facts, and would never indeed have obtained acceptance for an instant but for the carelessness with which such theories are too often dealt with, being presented as abstract ideas instead of being tested in measure and quantity.

The existence of the comet families of the giant planets can scarcely be explained without assuming, what we have already in another way been led to recognise,—the ejection from the giant planets of masses of matter in eruptions akin to those which take place in the sun. Whether such eruptions take place now in the giant planets or not would be difficult to prove, for although we have evidence of tremendous disturbances, we have nothing to show conclusively that these would suffice to eject matter for ever from within these planets' globes. Whether a careful study of the region outside the discs of Jupiter and Saturn would reveal aught throwing light on this matter, I am not prepared to say; but I am certain the edges of the discs of the giant planets are worth much more careful study than they have yet received. Undoubtedly many of the comets of Jupiter's family must have been added to the solar cometic system hundreds of thousands, if not millions, of years ago. But quite possibly both Jupiter and Saturn still eject matter from time to time with such velocities from their interior that it passes away never to return to them. In this as in many other features Jupiter and Saturn resemble the sun. They may be regarded as telling us in some degree what was the past of our own earth, when she was full of the fiery vigour of planetary youth. But they tell us more clearly what will be the future of our sun when the glowing vapourising masses now surrounding him have lost their intense lustre, and ceasing to possess his present life-giving qualities he is approaching the condition of dark suns which exist already in immense numbers within our stellar system.

ERRATUM.—In the third line from the bottom of the paragraph on Lunacy Law Reform, on p. 479 of Vol. V., "insure" should be "immure."

## PHOTOGRAPHING A FLASH OF LIGHTNING.

THE accompanying engraving was made directly from a photograph sent to us by Mr. W. C. Gurley, of Marietta Observatory, who writes as follows :—

"The reproduction of a flash of lightning by photography would, a few years since, have been deemed quite an impossibility, but the introduction of the rapid bromo-gelatine process has rendered it not only possible but comparatively easy of accomplishment.

"The accompanying photograph is from a negative taken by myself during a thunderstorm which passed several miles south of the observatory on the evening of May 4.

"Wheatstone has demonstrated by direct experiment that the duration of a single flash of lightning cannot possibly exceed a millionth of a second. That a photograph showing the detail of the one mentioned could be taken in this inappreciably short time seems quite wonderful, not to say incredible. The plate employed was one of Cramer's extra rapid, and developed with strong pyrogallic developer.

"It will be observed that the flash is not of the usually depicted zigzag form, and that it seems to be alternately contracted and expanded in its passage through the atmosphere.

"Taking the interval between the flash and the report, I estimated its distance from the camera to have been about five miles."—*Scientific American.*

---

The report on the composition and quality of daily samples of the water supplied to London, for the month ending May 31st, 1884, by William Crookes, F.R.S., William Odling, M.B., F.R.S., F.R.C.P., and C. Meymott Tidy, M.B., F.C.S., says:—"Of these 189 samples of water, the whole were, without exception, clear, bright, and well filtered. The quality of the water supplied to the metropolis during the past month, as indicated by its state of aëration, and high degree of freedom from colour and excess of organic matter, was excellent. Its perfect filtration was shown by the absence of even a trace of suspended matter in any one of the numerous samples submitted to examination."

## THE ANTARCTIC REGIONS.

By Richard A. Proctor.

THERE are parts of our earth of which we know less than of the moon, or even of some of the planets. The eyes of the astronomer have looked upon the unattainable summits of the lunar mountains; he has studied the arid wastes which lie within the lunar craters; he has measured the light which these regions reflect—nay, even to the degree to which they are warmed under the blazing sun of the long lunar day. Passing beyond the moon, the astronomer has studied the lands and seas of a world which has justly been termed a miniature of our earth: he has watched the clouds which form over the continents and oceans of the planet Mars, and are dissipated even like our own by the solar rays; he has determined the very constituents of that planet's atmosphere. But more than this, the astronomer has actually studied the condition of parts of Mars, where (if analogy can be trusted) the very inhabitants of that world are unable to penetrate. The ruddy orb which during the spring months was now conspicuous in our skies presents to the astronomer its Arctic and Antarctic wastes. He is able to watch the gradual increase of either region as winter prevails alternately over the northern and southern hemisphere of Mars; he can measure their gradual reduction with the progress of the Martial summer; and he can infer from their aspect that even in the height of summer there still remain ice-covered regions so wide in their range as doubtless to defy the efforts of the Martialists to penetrate to the poles of the globe on which they live. So that where most probably no living creature on Mars has ever penetrated, the astronomer can direct his survey; and questions which no Martial geographer can pretend to answer the terrestrial astronomer can discuss with a considerable degree of confidence. It is the same even with the more distant planets Jupiter and Saturn. Despite the vast spaces which separate us from these orbs, we yet know much respecting their physical habitudes; and whereas our knowledge of our own earth is limited by certain barriers as yet unpassed, and probably impassable, there is no part of the surface of either of the giant planets which has not come under the astronomer's scrutiny.

These considerations suggest in turn the strange thought that possibly the unattained places of our earth have been viewed by beings which are not of this world. I say *possibly*, but I might almost say *probably*. It seems in no degree unreasonable to suppose not merely that the earth's sister-planet Venus is inhabited, but that some creatures on Venus possess the reasoning powers and the insight into the secrets of Nature which have enabled the inhabitants of Earth to study the orbs which circle like herself around the sun. If this be the case—if there are telescopists in Venus as skilful as those inhabiting our earth—they are able to answer questions which hitherto have baffled our geographers. They may not, indeed, have the means of ascertaining details respecting the structure of our continents and oceans. They cannot know, for instance, whether the region to which Livingstone has penetrated is, as he supposes, the head of the river we terrestrials call the Nile, or, as others suppose, is in reality the head of the Congo. For certainly no telescopic powers possessed by our astronomers could give us information on such points, if our position were interchanged with that of the inhabitants of Venus. But astronomers in Venus can, without excessive telescopic power, inform themselves whether our polar regions are

like the corresponding regions in Mars—or whether, as many geographers suppose, the Arctic regions are occupied in summer by an open ocean, while in the Antarctic regions there is a large continent.

A new interest was given to inquiries respecting the condition of Arctic and Antarctic regions by the circumstance that the expedition of the *Challenger* is expected to bring us information respecting the latter regions, while application has been made for Government assistance towards an Arctic expedition. I propose to consider, now, some of the questions which are connected with Antarctic research, and in particular to discuss the probability of the existence of great continental lands within the Antarctic circle.

Before proceeding to consider these points, however, I have a few remarks to make on the question of Government aid to this branch of geographical research.

It should be remembered by those who discuss this subject that the first exploration of the polar regions of our earth had a commercial origin. It was supposed that by finding a passage round the northern shores of the American continent communication with China and the East Indies would be facilitated. A way had been found round Cape Horn, but the way was long, and the storms which rage in Antarctic seas rendered the route uninviting to the contemporaries of Magellan. The natural supposition in those days was, that voyagers from the great maritime northern countries—from England, from Spain and Portugal, or from the Netherlands—would find their advantage in sailing northwards rather than southwards. Hence the long and persistent efforts made to discover a north-western passage. Nor were the more directly Arctic voyages of Hudson and Richardson conducted with any other primary purpose. It is indeed manifest, as any one will perceive on examining a terrestrial globe, that a north-eastern course would avail nearly as well as a north-western for reaching eastern countries from Europe, and that a directly polar course would be better than either, if only (as Hudson hoped) a safe passage might be found through the Arctic seas.

Gradually, as the hope of finding a north-western passage available for commerce died out, other circumstances encouraged persistence in the efforts which had been made to penetrate the regions lying to the north of the American continent. There was much, indeed, in the desire to accomplish what had foiled so many; and it may be questioned whether this desire had not a good deal to do with the appeals which were made for Government assistance, as also with the ready response of Government to those appeals. Nevertheless, a real scientific interest had become associated with the search after a north-west passage. The magnetic pole of the earth was known to lie somewhere amid the dreary archipelago, with its ice-bound inlets and glacier-laden shores, through which our Arctic seamen had so long attempted to penetrate. There, also, lies one of the northern poles of cold; while the configuration of the isothermal lines (or lines of equal temperature) in the neighbourhood, shows how some influence is at work carrying relative warmth from the Atlantic towards the North Pole, and leaving the regions on the west of that course exposed to a degree of cold greatly more intense. To these considerations others connected with the whaling trade were added, though I am not prepared to say that (so far as the question of Government assistance was concerned) these considerations had very great weight.

It cannot be denied, however, that at a certain stage in the history of Arctic voyaging, the mere barren ambition to attain or approach the North Pole of the earth, was set in advance of more practical considerations. We find, for instance, that in the case of Parry's "boat and sledge" expedition from Spitzbergen polewards, certain sums of money were set as a reward for reaching such and such northern latitudes, the sum of ten thousand pounds being the prize for attaining the North Pole itself.

It would not be easy, perhaps, to assign any sufficient reason for the renewal, by a scientific expedition, of those arduous explorations in which Wilkes, d'Urville, and (especially) the younger Ross, discovered all that is known about the Antarctic ice-barrier. There was much, indeed, in the results obtained by Ross to invite curiosity on the one hand, and on the other to show that the Antarctic regions can be penetrated successfully in certain directions. It seems far from unlikely that other openings exist by which the southern pole may be approached, than that great bay, girt round by steep and lofty rocks, where Ross made his nearest approach to the southern magnetic pole. I shall presently indicate reasons for believing that the Antarctic as well as the Arctic regions are occupied by an archipelago — ice-bound, indeed, during the greater part of the year—but nevertheless not altogether impenetrable during the Antarctic summer. Yet there is little to encourage any attempts to explore this region otherwise than in ships specially constructed to encounter its dangers.

*(To be continued.)*

## THE INTERNATIONAL HEALTH EXHIBITION.

### VI.—WATER AND WATER SUPPLIES.

A PRELIMINARY inquiry into the nature of water would more become a treatise on chemistry than the present pages; yet, nevertheless, some definition must be given of this all-important matter to enable our readers to understand exactly what we have to deal with, and how intimately the subject is interwoven with all that concerns our healthy being.

Pure water, as such, does not come within the scope of our ordinary life; it only occupies a legitimate place in the laboratory of the experimental chemist, who defines it to be a combination of the elements hydrogen and oxygen in the proportions of two volumes of the former to one of the latter, or graphically, H—O—H. For further information on the physical properties of pure water, and of its elemental components, we must refer the reader to the numerous text-books on chemistry now in circulation. A popular lucid account of the subject may be derived from a perusal of the excellent little handbook entitled "Water and Water Supplies," by Professor Attfield, and published under the direction of the Executive Council by Messrs. Clowes & Sons, in the Exhibition buildings. Chemically, pure water, then, does not come within the field of our observations as inquirers into the usefulness of that medium. What, then, have we to deal with?

The water with which we are familiar may be defined as a compound of very variable character. Each sample would have to be analysed before we could pronounce with decision its distinctive attribute. In general, however, the term pure water may be taken to signify water which contains in solution and admixture various solids and gases, which, for domestic purposes, are not only harmless, but useful. It thus resolves itself into a question of relative utility; we say *relative*, because we speak of ourselves as human beings. Certain waters which are eminently suited to the propagation and nutrition of other living things,

XUM

would be absolutely poisonous to *Homo sapiens;* indeed, such deleterious waters are often so constantly associated with certain forms of life, both animal and vegetable, that their presence is always sufficient to determine the character of the liquid as unsuitable to man. The question may here be raised that it is the ingestion of the living things which produces the evil effects, and that is very true to a large extent; but besides the growth and multiplication within our bodies of disease-producing germs, the waters which they inhabit are chemically contaminated; the fermentative action which they set up therein results in the elimination of non-living substances, which, apart from the organisms themselves, are highly poisonous. And we would here suggest that the first rapid, and in some cases almost instantaneous, phase in zymotic diseases may not be so much due to the growth and development of the germs themselves, as to the poisonous ferments which they create, and which are imbibed along with them.

As instances of what we would here imply, we may point to the fermentative action of the yeast-plant (*Saccharomyces cerevisiæ*)*, which produces alcohol, and which, even after death through the administration of ether,† gives rise to a non-living soluble ferment, which transforms cane into grape-sugar. The alcohol and the glucogenic ferment retain their properties after the yeast-plant itself has ceased to exist. The butyric acid remains as butyric acid after the bacterium (*Bacillum subtile*) has passed away. Foul gases and putrefactive fluids remain after the death of *Bacterium termo;* and may we not with reason expect to find that the greater part of the mischief which ends in splenic disease, pulmonary tubercles, and leprous deformations, is the immediate cause of the ferments produced by their respective bacteria (*Bacillum anthracis*, *B. tuberculosus*, and *B. leprœ*); and that our physicians in their ætiological studies might direct some of their experiments towards finding antidotes for these poisons? Cannot a specific be found to neutralise the ferment of *B. tuberculosus*, and be applied so as to result in the reduction of tubercle in this way? We trust that the time has arrived when experimental inquiry shall partially turn from the inoculation of guinea-pigs and the preparation of microscopical slides from the tissues of the poor innocent victims, to the chemical side of the question, where the disease germs only shall be sacrificed at the altar of Æsculapius.‡

We are not digressing; we are only trying to show by living examples how very much this aspect of the water question has been neglected. Pages of matter have been devoted by various authors to the consideration of the purifying processes of Nature, such as the open flows of water in rivers, aqueducts, down cataracts, and gullies, and its percolation through the soil, subsoil, and rock to wells of great depth, all the arguments for which are based upon the theory that, through oxidation of organic remains, the harmful azotised and carbonaceous matters are converted into useful nitrates and carbon dioxide, and the water thus fitted for domestic purposes. Now, all this is very true about dead forms of life, but what about the living? And, still more, what about the nascent living or germ condition?

All *Bacteria*, but more particularly the forms termed *Bacilli*, are excessively minute bodies, chiefly of rod-like* shapes in their adult condition; they are assigned to the group of *Schizomycetes* amongst the lower *Fungi*. *Micrococcus* is a rounded form, and averages about $\frac{1}{25000}$ in. in diameter, or only 1 $\mu$.† *Bacterium termo*, the active agent in putrefaction, is about 1 $\mu$ in breadth by 1·5 $\mu$ in length. The majority of *Bacilli* are infinitesimal in size; in fact, in a specimen of the *Bacillum* of Oriental leprosy which recently came under our notice, it was difficult to detect any signs of the germs with a magnifying power of even 500 diameters; but with 1,000 diameters we were able to distinguish certain nests (stained methyl violet), in the substance of the fine connective tissue of the papillæ of the skin, which latter was tinged with Bismarck brown. On careful examination, these nests were seen to be composed of congeries of little rods, or *Bacilli*. So much, then, in proof of the minuteness of these disease-germs. The presence of oxygen and carbon dioxide given to the water can scarcely be held as destructive to such forms of life; they would rather tend to an opposite result. However that may be, bacteria are most tenacious of their existence; otherwise, how could they have survived the ill-treatment received at the hand of Dr. Bastian and other observers? According to Eidam‡ they are killed by a fourteen hours' exposure to a temperature of 40° C., or a three hours' exposure to 45° C. Their *germs* when *dry* can resist 110° C., but succumb when 120° C. is reached§. Tyndall‖ also has shown that infusions with bacteria are not sterilised unless they are subjected to prolonged boiling—about *four hours*. When moist, however, they are more easily destroyed; and here is the bearing of the germ question upon the water supply:—

The activity of the germs seems to be manifested only in the presence of moisture. Recent researches, especially those communicated to the Parisian Academy of Sciences, have shown that the air teems with these primitive forms; they have been actually strained therefrom, and an approximate estimation of their numbers in a given volume of the atmosphere at different seasons, places, and under specified conditions has been formulated. It has been shown that after a shower of rain the air is considerably purified of these organisms; they are carried down by the water into the soil, and there they increase and multiply under favourable conditions to vitiate the air once more with their countless descendants.

Their methods of reproduction have been ascertained through microscopical investigation; and, so far as we are aware, they are propagated ($\alpha$) by *fission*, or division of an adult into two individuals by constriction, and subsequent separation of the parts; ($\beta$) by a process closely allied to fission, called the *zooglœa* stage, in which division seems to be carried on in a passive state, embedded in a jelly-like surrounding; and ($\gamma$), as first shown by Koch,¶ and verified by Ewart,** through elongation of the rods into filaments, the internal portion of which becomes subdivided into small, highly refractive particles or germs, which are liberated through the bursting of the parent envelope.

* In reply to an inquiry as to the average size of the yeast cell, we may state that *our own* measurements were taken from the larger variety of the plant known as "German," "dry," or "baker's" yeast, viz., 12 micromillimètres, or about 1-2000 inch. Ordinary brewer's "barm," however, usually furnishes cells which measure only 8$\mu$, or 1-3200 inch approximately.

† Hoppe-Seyler, in "Watts' Dictionary of Chemistry," second Supplement, London, 1875, p. 522.

‡ The prevention of zymotic diseases by a prior removal of the germs from food substances does not so much concern our medical brethren, as our purely chemical *confrères*, naturalists, and practical workers. We may leave the *Æsclepiadæ* to cope with Archæus and his emissaries *after* the mischief has been done.

* *Bacterium*, from the Gr. *βάκτρον*, a rod or staff. *Bacillum*, dim. of Lat. *baculum*, a little rod.

† Here, as elsewhere, we shall denote the *micromillimètre* by the Greek letter $\mu$. 1 $\mu$ = 0·0000397 inch.

‡ "Beiträge zur Biologie der Pflanzen," by Cohn, Vol. I., p. 223.

§ Sanderson and Ewart in "Proc. Roy. Soc.," Vol. 28, p. 477.

‖ "Trans. Roy. Soc.," Vol. clxvii., pp. 149 et 177.

¶ "Beitr. zur Biol. d. Pflanzen," by Cohn, Vol. ii., p. 3.

** "Proc. Roy. Soc.," Vol. xxvii., p. 474.

This last process has been termed *multiplication by endogonidia*; and we cannot but fancy that it is to its potent agency that we are indebted for the myriads of germ forms which pollute the atmosphere. The inhalation of these germs, however, does not seem to be all-powerful in the spread of infections, as they are to a large measure intercepted by the natural filter, commonly known as the nostrils, and are further checked in their growth by the unfavourable secretions and gases given off by the glandular organs of our bodies; so that in the struggle for existence they are compelled to succumb, and their harmful action is thus arrested, or reduced to a minimum. The "nervous" or other pathological condition of the individual, of course, opens the gates even to these *dry* germs; but it is averred that persons in a normal state of health are able, at most times, to withstand their ravages.

When, however, they gain access to their hotbed of water, their activity is so stimulated that the poor unfortunate who gives them a reception must inevitably become a prey to these poisonous parasites. It thus becomes incumbent on all those to whom the welfare of their fellow-beings is entrusted, to the heads of families, as much as to water-supply companies, to learn something about these matters, and to seek for remedies, such as may lie in their power, which shall effectually prevent the spread of disease and the increase of mortality.

In this paper it has been our endeavour to show how seemingly insignificant yet subtle an influence,—an influence which can baffle the chemical or even the practised microscopical detective,—is at work undermining the constitutions of thousands of healthy lives. We shall in continuation of this subject show how those evils might be remedied, and what has already been done by practical workers in this field of inquiry. Our next communication will deal with the physiographical aspect of the water-supply question, suitably illustrated.

## ON PECULIARITIES OF SIGHT, AND OPTICAL ILLUSIONS.*

BY NATH. E. GREEN.

ALMOST interesting and instructive paper might be written on the subject of optical illusions in connection with astronomical observation. How many minute companions to stars, how many extra satellites of planets, how many strange appearances, have been seen by certain observers, and by them only. Yet those observers believed in their own sight, and were fully convinced of the actuality of the appearances reported. May not an explanation be found in the eccentricities of optics or in personalities of vision?

The object of this paper is to draw attention to the subject, and by a few confessions to induce others to take it up, being assured that, although the individual may feel depressed, the great cause of truth will be advanced by the discussion.

And first, with regard to minute points of light. The writer has experienced a difficulty when searching for faint comites, or the inner satellites of Saturn, in determining which are real and which spurious points. The eye having a tendency to produce these where they do not exist, and the real things being only seen by glimpses, it requires great patience, and frequent repetition of a point in the same position to be assured of its existence. A friend once remarked when searching for the satellites of Saturn, "How many do you want me to see, for I can see as many as you like." Surely this optical illusion will account for the appearance of many minute objects, that others have been unable to confirm. Another illusion is the persistence of an object on the retina after the eye has been withdrawn from the telescope. This has occurred after long observation of Jupiter with an 18-in. reflector. On removing the eye from the instrument, to make a drawing of what has been observed, a clear, bright disc has so interfered between the eye and the pencil-point, that an effort was required to remove the illusion before the drawing could be made. May not this retention of an object on which the eye has long been fixed account for the appearance of a satellite *through* the limb of Jupiter, the image of the satellite being continued on the retina after it had passed behind the planet?*

But what shall we say of the reported visibility of the unillumined portion of Venus? This phenomenon has been reported so frequently that it seems like heresy to doubt the fact. We are not referring to the fine ring of light that surrounds the disc just before immersion at a transit, or when Venus is very near the sun at inferior conjunction, but to those reported appearances, in full daylight, when the planet is at greatest elongation. The writer had a friend who could always see the dark side, even in the finder; he has shown Venus to another unaccustomed to astronomical observation, when the planet was on the meridian and about half full. "How is it," said he, "that I see the whole of the round?" And very recently, when friends were in the observatory, and viewing Venus, on putting the question, "Can you see the unillumined portion?" the answer has been, "Now you mention it, I think I can." In all these cases, and many others, the writer has been unable to perceive that which others have seen.

One more illusion, and we have done. When observing the ring of Saturn, and especially the outer ring, for evidences of division, a very distinct shadow of Saturn has appeared on the following portion of the sky—this is, of course, a simple optical defect, arising possibly from the same cause as the dark forms that are seen after looking at the sun. It is just possible that a similar effect follows Venus, and to some eyes appears like the dark portion of the planet against the sky.†

There is a fine opportunity before us of testing some of these appearances, and the readers of this journal may be induced to record their experiences.

DURING the year 1883, Professor Simon Newcomb, U.S.N., visited Europe, by order of the United States Government, for the purpose of collecting information respecting the most recent improvements in astronomical instruments. His report to the Secretary of the Navy contains a good deal of valuable information for the practical astronomer. He speaks highly of the definition of the enormous refractor at Vienna. He also commends the method of supporting mirrors devised by the MM. Henry of Paris, adding, however, that it has, so far, not been employed with reflectors exceeding 12 in. in aperture. He by no means speaks with unmixed admiration of the much bepuffed "Equatorial circle"; while he has little but praise for the Strasburg circle under construction by the Messrs. Repsold. One of the most interesting things described by Professor Newcomb is the extremely shallow form of mercury basin employed for reflection-observations at Strasburg, Leyden, &c.

* From the *Astronomical Register*.

* This is, however, inconsistent with the accounts given by Mr. Todd, of Adelaide, and his assistants.—R. P.

† This seems to me just *im*possible. The dark shade seen in this way is of the same shape as the luminous object, and similarly situated: the "terminator" of Venus is not of the same shape as the outline of the unillumined part of the disc.—R. P.

# THE EVOLUTION OF FLOWERS.

By Grant Allen.

## SOME HIGHER LILIES.

ALL the true lilies with which we have dealt so far have had bulbs to grow from, and have been, on the whole, very succulent and herbaceous in character. They have also persisted in the primitive lily habit of producing dry capsules, each of the three cells in which contained numerous seeds.

There are, however, some higher types of lily, not very largely represented in our British flora, which differ considerably from the tulip, the fritillary, and the tiger-lilies in one or other of these central characteristics. I propose briefly glancing at two of these to-day, the common asparagus (*Asparagus officinalis*) and the butcher's broom (*Ruscus aculeatus*). They are our two English representatives of the sub-order of Liliaceæ known as Asparageæ.

Dismiss from your mind entirely the ordinary garden

Fig. 1.—Asparagus Officinalis.

notion of asparagus, as a thick, stumpy, succulent shoot, and try to realise the life of the wild plant itself as it grows by the sandy, tideless levels of the Mediterranean, or far more sparingly on a few isolated rocky headlands of our own Cornish or Irish coast. Essentially a maritime weed, the wild asparagus has, instead of a bulb, a deep creeping root-stock, buried far out of harm's reach in the sand or the crannies; and from this stock it sends up every spring a few soft, scaly, annual shoots, thin and wiry, which branch out afterwards into tufted feathery heads of minute foliage. In our gardens, we trench and manure the selected and cultivated variety, so that each year the annual stems grow very large, high, and bushy, and collect abundant material for the next spring's growth, which they conceal during the winter in the buried root-stock. Hence the young shoots in the garden kind have become unnaturally large, thick, and luscious. But in the wild state, asparagus seldom attains more than one quarter the height of the big, luxuriant, cultivated variety, and its spring shoots are far thinner, stringier, and more woody in texture.

On the edible young stems of the garden asparagus, everybody must have noticed a few short, stumpy scales, generally of a faint mauve colour; and these are almost the only true leaves the plant ever produces. When it grows older, the place of foliage is fulfilled by the fine clustered hair-like green points, which are, in fact, very small branches, or, if you like to be extremely scientific, abortive pedicels (that is to say, flower-stalks whose buds and blossoms have never developed). Look very closely at the base of each such cluster—the full-grown garden asparagus will do quite as well for this purpose as its wild ancestor—and you will see that it is enclosed by very tiny dry scales, each of which is really a bract or leaf, similar to those on the spring shoots. From the axils or angles made by these bracts with the stem, the cluster of abortive pedicels springs, just as each separate blossom in a wild hyacinth or a common spotted orchis, springs from a small bract of a far more conspicuous character. One may say, in fact, that each cluster of so-called leaves in the asparagus answers to a whole head of flowers in the bluebell or orchis, only that the actual blossoms themselves are in this case never developed.

Why the asparagus has thus taken to producing these innumerable pedicels instead of true leaves would be a long and difficult question to answer fully. It must suffice here to say briefly that in many plants of dry places (for example, in the stonecrops) the stem and branches as well as the leaves are filled with chlorophyll, and help to perform the foliar functions. In others (for example, in the cactuses) the true leaves have dwindled away absolutely to nothing, because the succulent stem performs their functions better under its own peculiar circumstances. In asparagus, the true leaves remain only as protective scales, but the work of foliage has been taken on by the stem and pedicels, simply because they could do the work more conveniently.

The flowers of the asparagus are small and greenish, and at first sight very inconspicuous. On looking closer, however, you will see that they are perfect little lilies, each with six distinct perianth-pieces—that is to say, three sepals and three petals, the distinction being here well marked—and the usual six stamens and three-celled ovary. Many of the flowers, however, have stamens only; others have pistils with abortive stamens: the plant is just beginning to separate the sexes in distinct blossoms. But the separation has not yet gone far; none of the female flowers have as yet quite lost their stamens, though they are reduced to useless filaments bearing abortive anthers. Indeed, a few blossoms on each plant usually still retain both stamens and pistil. Unattractive as they are in colour, the asparagus flowers have a delicate perfume, and secrete abundant honey; hence they are visited and fertilised by hive bees and a few other insects.

But the most marked peculiarity about the asparagus, as distinguished from the other lilies we have hitherto examined, is certainly the fact that it produces red berries, instead of dry green or brown capsules. This berry has, of course, been produced, like all others, by the intervention of birds, which thus distribute the seeds in the best possible situations. Accordingly, the plant is able to lessen the number of seeds in each cell to one only. To be sure, the flower has two ovules or young seeds in each cell of the ovary; but as the fruit ripens, one of these usually becomes abortive. This is just the exact reversal of what we saw happen in an earlier stage of evolution; and yet it is only

a further step in the same direction, under a slight disguise. We noticed that the earliest monocotyledons, such as the alismas, had many carpels in every flower, each containing one seed. In the simpler lilies, such as the tulip and fritillary, the number of carpels was reduced to three (united in a single capsule), while, by way of compensation, the seeds in each cell were increased to several. But in the asparagus, the improved mode of dispersion by the aid of birds enables the plant still further to simplify its plan by reducing the number of seeds in each cell to one. It thus effects the greatest possible saving both in fertilisation and in dispersion of seeds.

The butcher's broom is a still more singular modification of the lily type, in which the foliar functions are performed by flattened, leaf-like branches, exactly simulating true leaves. It stands alone among British monocotyledons in attaining a shrubby, woody, tree-like habit. The branches are so extremely like leaves in outward appearance that their true nature can only be discovered by reasoning and analogy. Most of them bear on their under surface (or rather on the upper side, which is so twisted as to turn

Fig. 2.—Ruscus Aculeatus.

downward) a single small, whitish lily flower, having six distinct perianth pieces, and either three stamens or a three-celled ovary, for the division of the sexes is here almost complete, though a few hermaphrodite blossoms occasionally occur. If you look very closely, however, you will see that each flower is borne on a small pedicel, united along its whole length with the leaf-like branch (well shown at *b* in the accompanying woodcut), and that a very tiny scale or bract lies under every blossom. Similar very small scales, the last relics of the true leaves, now abortive, are found beneath the leaf-like branches. The flowers and fruit seem accordingly to grow out of the middle of a leaf, a peculiarity which gives butcher's broom a very strange and uncanny appearance. In the immature ovary, there are two ovules in each cell, but, as the fruit ripens, one in each cell always becomes abortive, so that at most there are but three seeds in the berry. More often, however, only two perfect seeds are developed, and it is not uncommon to find berries with only one; so that butcher's broom, in fact, carries all the tendencies of the asparagus just one stage further. The berries are bright red, and very attractive to birds, but the seeds are excessively hard and indigestible. Butcher's broom is a glossy evergreen, and the leaf-like branches are stiff and prickly, effectually deterring cattle from browzing off its tempting foliage.

## CONCEIT (FOR SELF AND FAMILY).

BY RICHARD A. PROCTOR.

MY friend Mr. Foster has touched on the thought—a sound and suggestive one—that what is called patriotism is often only a wider development of selfishness. The least cultured among men are personally selfish, family selfishness is less contemptible but yet contemptible enough, and the selfishness of so-called patriotism is by comparison, but by comparison only, almost respectable. (I say so-called patriotism, for real patriotism is as distinct from the quality in question as just self-regard is from pure selfishness.)

But may we not in like manner recognise in false patriotism something akin rather to self-conceit, and conceit of family, than to selfishness of the personal or of the family kind? And may we not also distinguish between self-conceit and self-knowledge, precisely as we distinguish between selfishness and due self-regard?

Self-conceit is so obviously a fault of the uncultured and ill-developed mind that it is hardly necessary to dwell on the evidence of inferiority which it affords. This is curiously shown by the way in which this quality is manifested in children. Almost all children are more or less conceited,—generally more,—and grow out of their conceit (if it is in them to develope higher things) as they get older, just as they grow out of the monkeyhood of early infancy (often a very pretty monkeyhood) and the savagery of later childhood. Of course, many remain self-conceited to youth and manhood, or through life. Our less-developed classes are as inherently self-conceited through life as all or nearly all men are in early childhood. That supreme self-conceit presented in Tennyson's fine picture of the Northern Farmer, will be found, by any one who takes the trouble to search for it, in ninety-nine out of a hundred of our peasantry and men of purely agricultural life, even when the age supposed to be full of wisdom and experience has been reached. It seems incredible, but talk to men of the class to which Tennyson's "Northern Farmer" belonged and you will find many who doubt (at the bottom of their minds) whether Godamoighty quite knows their full value in the world. "Does Godamoighty knaw what a's doing a taakin o' me?" asks the old pagan, and we smile at his amazing self-conceit; yet it is common enough, and even outside those classes whose pursuits involve little calculated to raise the mind's level or to widen the ideas.

Family conceit is less obviously a sign of incomplete development; yet there can be little mistake about its real meaning when we rightly apprehend its nature. The child shows family conceit a little later than self-conceit, but the quality is essentially one belonging to childhood either of the individual or of the race. The Northern Farmer, though he had not passed much beyond the stage of self-conceit ("See how quolity smoiles when they sees me a passin' by"), had some family conceit too, if we fully understand his reference to "Jones, as never mended a

fence," and "Robinson, as arn't a haporth o' sense." Doubtless the Joneses and the Robinsons seemed to him to belong to an inferior race, besides being individually and personally contemptible. But family conceit is more widely spread (as well as a wider form of conceit) than conceit of self. We find it in races a grade higher than those which supply the chief developments of personal conceit. It yields more slowly before culture and knowledge. We see it in families which have every means of recognising the inherent absurdity of the feeling, who have before them as clearly the evidence of the insignificance of particular families as they have before them the evidence of the personal insignificance of the individual man. It is indeed true that, among the worst developed races, family conceit is more prevalent than in races which have had better advantages. The Flanagans and Dohertys are naturally full of pride of family, and prepared by breaking heads after due coat-tail-treading to show the superiority of the race which may be has not produced in all time a single person above or even quite up to the average; and in like manner in our own country we find a steady though dull form of family pride in the Noakeses and Styleses of remote and undeveloped country districts. But the failing is found outside such races as these. It can not only be recognised in families called noble and royal (it comes out amusingly for instance, so far as I can judge from extracts, in some royal books which have recently been published in this country) but it can be recognised also in those whose opportunities of culture and study should have taught them better. Nay, sometimes even that special study of biological laws which should show that each individual represents scores of families and has qualities which can no more be assigned to one family than the qualities of a river can be assigned to one out of its hundred sources, fails to correct this foolish feeling, which like others of our lower qualities is innate and scarce to be corrected by culture, reasoning, or acquired knowledge.

What however can be much more absurd in reality than to find a family claiming for its members—or quietly assuming without claiming openly—superior qualities? We know that the very existence of family conceit is a mark of want of sense, a sign of inferior culture. But apart from this we know that every person born into the world shares multitudinous faculties and qualities inherited from hundreds, thousands, nay tens and hundreds of thousands of foregoers. When a man boasts "I am a Snillum or a Snobbig" he can really only mean that a thousandth part of his blood comes from some remote Snobbig or a Snillum, of presumably better qualities than they recognise in themselves—so that their family history has—by their own account—been one of descent. It is sad for them, but they ought to know best. Still the idea of a family strain is absurd on the face of it, and family conceit is only less contemptible than personal vanity.

---

IN a description of the mowing and reaping machine works of Mr. W. A. Wood the following occurs:—"Statement of materials we consumed in the manufacture of 45,032 machines, our production in 1883. We give only the principal materials used. Pig-iron, 10,500 tons; steel, 1,000 tons; wrought and cold rolled iron, 4,500 tons; malleable iron, 1,600 tons; coal, 7,000 tons; coke, 1,000 tons; moulding sand, 4,000 tons; grinding stones, 225 tons; painting material, 490,000 lb.; spring wire, 60,000 lb.; tacks and rivets, 120,000 lb.; brass and composition, 120,000 lb.; screws, 10,000 gross; lubricating oils, 10,000 gallons; lumber, 10,000,000 ft.; cotton duck, 90,000 yards; carriage and plough bolts, 3,000,000. As evidence of the magnitude that the use of self-binding machinery in harvesting grain has attained, we will state that we furnished our customers in 1883, 2,500 tons of twine."

## Reviews.

### SOME BOOKS ON OUR TABLE.

*What is Art?* By JAMES STANLEY LITTLE. (London: W. Swan, Sonnenschein & Co. 1884.)—If we may judge from internal evidence, Mr. Little is an artist who, like the unfortunate Haydon, believes that Society is wilfully blind to his genius; and in whose mind the rejection of his works by the Royal Academicians has induced a feeling the reverse of friendly towards that body. We may be mistaken, and Mr. Little may be speaking in parables; but we can put no other interpretation upon certain passages in his book. Be his object, however, what it may, he sets down many things (in somewhat too inflated language) which may well be laid to heart by all who are concerned for Art progress in England. His claim for the pre-eminent dignity of Landscape Art is not, in the present condition of popular taste, likely to be conceded; albeit the study of his utterances on this point might not be without profit to the devotees of the empty-perambulator and kitten-playing-with-string school of painting. His protest against shoddy is none too vigorous.

*A Short Text-Book of Inorganic Chemistry.* By DR. HERMANN KOLBE. Translated and Edited by T. S. HUMPIDGE, Ph.D. (London: Longmans, Green & Co. 1884.)—"This short text-book," says its author in his preface, "has been written to recall to the memory of students who have attended a course of lectures on Experimental Chemistry what they have seen and heard, and to clear up any points which may not have been properly understood." Assuredly both Dr. Kolbe and his translator may be congratulated on the success with which they have fulfilled their self-imposed task; for in the 606 closely-printed pages before us will be found the means of obtaining the most thorough grounding in Inorganic Chemistry. Dr. Humpidge has added to his lucid translation short accounts of Gay Lussac's law, the law of Avogadro, and the manufacture of coal-gas; and has further supplemented the descriptions of various elements and compounds in the text. He has also contributed an appendix containing an account of the methods used for determining atomic and molecular weights, of Prout's law and of the Periodic law, as well as a series of useful tables. A beautifully lithographed table of spectra forms the frontispiece; numerous woodcuts are inserted in the text, and there is a good and exhaustive index to the whole book. It forms no unworthy addition to the Messrs. Longmans' admirable series of Text-books of Science.

*Rock History; a Note-book of Geology.* By C. L. BARNES, M.A. (London: Edward Stanford. 1884.) It is long since we have come across an introductory work on geology at once so practical and attractive as this of Mr. Barnes. While admitting his obligation to Lyell's "Student's Elements of Geology," our author must be credited with having employed his materials in about as convenient and instructive a form for the student as he could well have adopted. He commences with an enunciation of the general principles of geology, and then proceeds to treat of the physical structure, composition, stratification, and ages of the various rocks. Having thus familiarised the beginner with the structure of the earth's crust as a whole, Mr. Barnes goes on to apply and illustrate the knowledge thus acquired in a way which has much, beyond its novelty, to recommend it. He deals with the various formations *seriatim*, commencing with a succinct account of each. This is followed by a table giving in the first column the divisions of the formation described; in the second

column, the places of its occurrence in England and Wales; in the third the localities of its occurrence abroad; in the fourth its lithological or petrological character; in the fifth the climate prevailing when it was deposited; in the sixth the leading fossils which characterise it; in the seventh its thickness in the British Isles; while the eighth is occupied with general elucidative remarks. Finally comes a map of England and Wales, in which the formation treated of only is coloured (this strikes us as an excellent idea); while opposite each map is a well-executed chart containing drawings of the fossils most characteristic of the rocks described. Then follows a chapter on the igneous rocks, a table of the classification of the animal kingdom—together with the more important fossil examples of each division; while the work concludes with a glossary of the geological and palæontological terms employed in the body of it. No one about to make a tour in his own country this summer should omit Mr. Barnes's capital little book from his outfit.

*Handbooks: International Health Exhibition* (London: William Clowes & Son. 1884).—This eminently practical series of handbooks is worthy of the large circulation which it will undoubtedly command. In it Mr. Paget deals with "Healthy Schools;" Mr. Acland, C.B., F.R.S., with "Health in the Village;" Dr. Attfield, F.R.S., with "Water, Water Supplies, and Unfermented Beverages;" Mr. Berdmore on "The Principles of Cooking;" Miss C. T. Wood on "Food and Cookery for Infants and Invalids" (with an introduction by Dr. Cheadle); Surgeon-Major Evatt on "Ambulance Organisation, Equipment, and Transport;" and Capt. Shaw, C.B., on "Fires and Fire Brigades." Of these capital little volumes, the second, fifth, and sixth are illustrated, Mr. Acland's and Dr. Evatt's profusely, while Capt. Shaw gives a series of engravings depicting the appliances for extinguishing fire in 1667, 1707, and 1884. The reader interested in either of the subjects discussed in this series may select his volume by its title, with the certainty that he will find the matter treated of at once pleasantly, intelligently, and (for practical purposes) exhaustively.

*A Practical Introduction to Medical Electricity.* By A. DE WATTEVILLE, M.A., M.D., B.Sc., &c. Second Edition. (London: H. K. Lewis. 1884.)—Dr. de Watteville's book furnishes a species of Thesaurus for the medical electrician, so thoroughly is every branch of its subject treated on. There is, unhappily, so much advertising quackery in connection with medical—or pseudo-medical—electricity nowadays, that a real and appreciable service is rendered to therapeutics by a physician of our author's professional standing offering such an exposition as that whose title heads this notice, based upon purely scientific principles. In it he discusses the leading theorems of electro-physics, describes in detail the various forms of apparatus employed, and treats in succeeding chapters of electro-physiology, electro-diagnosis, and electro-therapeutics. His volume should be on the shelves of the consulting-room of every one whose name appears in the Medical Register.

*Treatise on Consumption*: A Work for the Million. By WILLIAM DALE, M.D. (London: Francis Hodgson. 1884.)—In a country in which the fell disease Phthisis annually claims so many victims as it does in our own, Dr. Dale's pamphlet must possess a painful interest. In it, after an introductory chapter, he successively deals with the causes of consumption, infection and phthisis, and lastly of its treatment. His style is readable and agreeable, and his book may be studied, not without profit, by all who have or imagine they have what is popularly known as "a delicate chest."

*Health Assurance.* By WM. FLEMING PHILLIPS. (London: Wyman & Sons. 1884.)—This little pamphlet developes an idea which strikes us as being an eminently common-sense and feasible one. Put as shortly as possible, it is that the well-to-do classes should pay a certain sum per head, ill or well, annually to their medical attendants, much as is already done in medical clubs by those in a lower rank of life. For the details of Dr. Phillips's scheme we must refer the reader to his pamphlet itself. It only costs sixpence, and will repay perusal.

*The Laundry Guide*, by W. J. MENZIES, contains useful recipes for softening water, making laundry soap, &c.

We have also before us *Naturen*, published in Christiania; *The Bulletin de l'Agence Générale de l'Electricité*, Paris; *The Railway Review*, Chicago; *Bradstreets*, New York; *The Dyer, Calico-Printer, and Colour Trades Review*, London; *The Tricyclist*, London; *Ciel el Terre*, Brussels; and *Society*, each addressing its own extensive and influential section of the public.

*The Practical Telegraphist.* By W. LYND, A.S.T.E. (London: Wyman & Sons, 1884.)—This is a work which will doubtless prove useful to those interested in telegraphy. In the main it is a miscellaneous compilation from several reliable authorities. Details are given of the system of working and of the principles and construction of several instruments adopted in the Postal Telegraph Service. The volume concludes with interesting, and, we may say, valuable statistics, pourtraying the marvellous development of telegraphy at home and abroad. The work is got up in a style highly creditable to the publishers.

*Telegraphy.* By W. H. PREECE, F.R.S., M.I.C.E., and J. SIVEWRIGHT, M.A., C.M.G. Third Edition. (London: Longmans, Green, & Co., 1884.)—This work, which is responsible for a very large proportion of the volume previously noticed, occupies the position of being without a rival in its particular sphere. It is, for its size, very comprehensive, while the language is simple and clear. These reasons, combined with a moderate price, have so far secured for it immunity from competition. The new edition embraces chapters on the telephone, fast repeaters, and quadruplex telegraphy, additions of great value. Notwithstanding one or two little slips, the book is to be highly commended, and will take a lot of beating.

## Editorial Gossip.

I REGRET to say that Mr. Thomas Foster has been recommended by his medical advisers a transatlantic journey. The promised concluding paper of his series cannot appear this week; but as he has somewhat wilfully determined to continue his literary work during the journey, it may be expected to appear very shortly, as it will probably be posted for England immediately on his arrival in New York.

MANY correspondents ask me if any photographic portrait of my editorial countenance is extant. Messrs. Elliott & Fry have recently requested me to sit for some new photographs. The pictures, which I regard as very satisfactory, are, I believe, now ready for issue.

ONE of the letters last week unfortunately escaped correction, and the result is that some rather remarkable new Greek words appear.

XUM

"A LADY" has received many letters relating to the rational dress in that form which cannot be distinguished from ordinary dress, but is as light, or almost as light, as the more obtrusive divided skirt. We believe that patterns will before long be provided for those who care to obtain them; when ready they will be advertised in these columns.

## THE FACE OF THE SKY.

FROM JULY 4 TO JULY 18.

BY F.R.A.S.

THE sun continues to provide daily work for the observer, and should be examined with the telescope whenever the sky is clear. The aspect of the night sky will be found delineated in Map VII. of "The Stars in their Seasons," twilight, however, still persisting all night long. Mercury is a morning star to-day, but comes into superior conjunction with the sun at 5 a.m. on the 13th, upon which, of course, he becomes an evening star. Venus will be in inferior conjunction with the sun at 2 a.m. on the 12th. Every effort should be made by the student to observe her in the telescope at and about this time, as she presents one of the most exquisite and all-repaying spectacles that it is possible to conceive, shining as a hair-like semi-circular thread of silver in the glare of sunlight. Moreover, under really favourable atmospheric circumstances, and a sufficiently-constricted telescopic field, the observer may hope to see the dark body of the planet embraced by this wonderful silver hair of light, like "the old moon in the new moon's arms." At noon on July 11th Venus will be approximately 4° 51′, or about 10 diameters of the sun, south or below his centre. This may help the beginner to fish her up with a telescope not mounted equatorially. No other planets are visible at present. Three occultations of stars by the moon occur during the fourteen days covered by these notes. The first happens on the night of the 11th, and is one of the fourth mag. star $\theta$ Aquarii, which will disappear at the moon's bright limb at 11h. 18m., at an angle of 67° from her vertex. It will re-appear at her dark limb at 12h. 29m. p.m. at a vertical angle of 279°. On July 15, the fourth mag. star $o$ Piscium will disappear at the bright limb of the moon at 12h. 53m. p.m., at an angle from the vertex of 60°. It will re-appear at 51m. after 1 the next morning, at an angle of 264° from her vertex. Lastly, on the 16th, rather more than half-an-hour before the moon rises, she will have occulted 31 Arietis, a star of the sixth magnitude. Later, at 11h. 55m. p.m., this star will re-appear at the moon's dark limb at a vertical angle of 246°. When our notes begin, the moon is in Libra; but at two o'clock this afternoon she leaves it for the narrow northern strip of Scorpio. She takes until one o'clock to-morrow morning to cross this, and then enters Ophiuchus. This she quits at 10 p.m., on the 6th, for Sagittarius. Her passage through Sagittarius occupies until 11 a.m. on the 9th, at which hour she passes into Capricornus, the boundary between which and Aquarius she crosses at 5 a.m. on the 10th. About 3 a.m. on the 13th, she leaves Aquarius for Pisces, and continues to travel through that large and straggling constellation until she enters Aries, at 5 a.m., on the 16th. At 8 p.m., on the 17th, she moves into Taurus, which she is still traversing when these notes terminate.

THE "Researches on Astronomical Spectrum Photography" of the late lamented Professor Henry Draper have just been republished, with an introduction and description of the apparatus by Professor C. A. Young, and measurements and description of the plates by Professor E. C. Pickering, together with reprints of Dr. Draper's various papers on the subject. Apart from its enduring importance as a record of a mass of valuable physical facts, and as containing a history of the infancy and youth of Stellar spectral research, this posthumous volume of the great American physicist possesses a high degree of interest, as showing what an enormous amount of scientific work of the highest value could be performed by an absolutely unsubsidised observer. Professor Draper would have felt that he was inflicting as much degradation on science as he would have brought upon himself personally had he gone whining to Congress for "endowment." Like our own Faraday, though, he "had no time to get rich;" and his name will assuredly live in honour when those of the men whose idea of science is narrowed to that of their own pecuniary advancement will have long sunk into oblivion.

"Let Knowledge grow from more to more."—ALFRED TENNYSON.

*Only a small proportion of Letters received can possibly be inserted. Correspondents must not be offended, therefore, should their letters not appear.*

*All Editorial communications should be addressed to the* EDITOR OF KNOWLEDGE; *all Business communications to the* PUBLISHERS, *at the Office, 74, Great Queen-street, W.C.* IF THIS IS NOT ATTENDED TO DELAYS ARISE FOR WHICH THE EDITOR IS NOT RESPONSIBLE.

*All Remittances, Cheques, and Post Office Orders should be made payable to* MESSRS. WYMAN & SONS.

*The Editor is not responsible for the opinions of correspondents.*

NO COMMUNICATIONS ARE ANSWERED BY POST, EVEN THOUGH STAMPED AND DIRECTED ENVELOPE BE ENCLOSED.

### LARGE CELLS FOR ELECTRO DEPOSITION.

[1322]—Mr. Slingo's last paper on "Electro-plating," in which he refers to the expense of rectangular baths made of pottery, reminds me of my own experience in the early days of electrotyping (about 1845–6). I made two large tanks for depositing copper 4 ft. long, 2½ ft. wide, and 2½ ft. deep. They were of common deal, put together in the usual way, by dove-tailing; but were double. The outer tank was about 1 in. thick; the inner tank was made of ½ in. wood, with outside dimensions ¼ in. less all round than the inside dimensions of the outer trough. On the bottom of the outside tank were a few small blocks about 1 in. square and ¼ in. thick. Thus, when the inner or lining tank was put in its place, resting on these blocks there was a space on all sides and the bottom of ¼ in. thickness between the inner and outer tank. To keep the lining accurately in the middle, I put temporary strips ¼ in. thick down each side.

This being arranged, I poured melted pitch into the ¼-inch space, only in sufficient quantity, *at first*, to flow over the bottom and rise a few inches above the sides, as I anticipated a floating up of the whole of the inner case if all the liquid were added at once. On the following day, after this first pouring had cooled and solidified, I poured more, sufficient to fill the ¼-inch space completely, and then left the whole to solidify. Then followed a curious illustration of the viscosity of the apparently solid pitch. The inner case gradually rose day by day, threatening to wreck the whole arrangement. I filled it with water, and it gradually sunk until it rested on the cheek blocks, where it remained when subsequently filled with the copper solution.

The second compound trough was similarly treated, and both were used by myself for two years without leakage, and long afterwards by my successor. The copper solution soaks through the porous wood of the inner lining, but is effectually resisted by the surrounding wall of pitch. I do not recommend this for *silver* solutions; the cyanides are alkaline, and will act upon the pitch, and thus, in course of time, the solution will become polluted by a solution of the pitch. This does not happen to the acid copper solution. Now that paraffin wax is obtainable for 6d. per pound, I recommend it as a substitute for the pitch, and have no doubt that cells thus constructed will be found available for all kinds of solutions that are used cold.

W. MATTIEU WILLIAMS.

### COLOUR-LANGUAGE.

[1323]—The construction which Mr. Titchener (question 1320) puts on my sentence is justified by the wording, but so general a statement must be interpreted by the spirit and context, rather than solely by the letter.

For it is not pretended that uncivilised folk can so discriminate between the subtle gradations of colour as to have words for every shade, but it is none the less certain that where terms are invented for colours, the concrete precedes the abstract.

Mr. Titchener's question gives me the desired occasion to call attention to my friend Mr. Grant Allen's delightful book on the "Colour Sense" (Trübner & Co.), and especially to the last chapter "On the Growth of the Colour-Vocabulary," from which the following is quoted:—

"The earliest names must be names of things, or of visible and

audible actions. . . When we wish to express a hitherto unnamed colour, the simplest way of doing it is to take an object which possesses that colour and apply its title as an adjective to the thing which we wish to describe. A particular shade of very light yellow has no distinctive name, but we must call it something for some special purpose, and so we think of its nearest common representative, a *primrose*. Thenceforward the new name becomes an adjective, and we ask naturally for a yard of primrose ribbon. Now, what we see civilised men doing to-day under our own eyes, primitive men did centuries ago, when they framed the earliest colour names. It would seem at present as though the various terms for colours might be divided into two classes—the truly abstract, such as *blue, green, yellow*, and the concrete used abstractly, such as *lilac, orange, pink*. The former class appears to have no other meaning than that of pure colour; while the latter class are clearly derived from the names of concrete objects. But in reality the difference between them is merely one of time. Abstract colour-terms are the names of concretes, whose original signification has been forgotten" (pp. 252, 253). EDWARD CLODD.

## DIVISIBILITY BY SEVEN.

[1324]—Mr. Askew, in 1274, May 30, asks for a proof of a method for ascertaining the divisibility of a number by 7, which he states to have been discovered by Mr. Rickard, of Birmingham. Probably many have discovered it: my father did, for one, and taught it to me some thirty years ago. The test-number is equally useful for 7, 11, and 13. The method, as worked by my father, gives, in the case of a number divisible by all three factors, the other factor as well, without further labour: and in this respect it has an advantage over that of Mr. Rickard.

If a number, N, be marked off from the right-hand end in periods of three digits; and if $a$, $b$, $c$, &c., be the periods; and if M be the difference between the sums of the alternate periods; we have, writing $r$ for 1000,

$$N = a + b\,r + c\,r^2 + d\,r^3 + \&c.$$
$$M = a - b + c - d + \&c.$$
$$\therefore N - M = b\,(r+1) + c(r^2-1) + d(r^3+1) + \&c.$$

and is divisible by $(r+1)$; hence, if M be divisible by $(r+1)$ or any factor of it, so also is N. And in this case $r+1 = 1001 = 7 \times 11 \times 13$.

My father's rule was to set the right-hand period under the next, and subtract, setting the remainder under the next, and so on. In the last period, the subtraction is *downwards* if the lower number be the larger. In this instance, since we have 1 to carry into the last period, the 931 must be read as 932. The ultimate remainder, 924, is the test-number; and, since this is divisible by 7 and 11, so also is the whole number.

```
  8 | 026 | 518 | 423
931 | 095 | 423 |
----
924
```

If the test-number chanced to be zero, the second line would be the quotient produced by dividing the given number by 1001; *i.e.*, it is the factor remaining after dividing out 7, 11, and 13. For let us call the second line "V;" writing three ciphers at the end, we get 1000V; and we know that, if this be deducted from the upper line, the remainder = V. Hence N = 1001V = 7 × 11 × 13 × V. In the above example, if the left-hand period were 932 instead of 8, the test-number would be zero.

If the periods be *single* digits, *i.e.*, if $r = 10$, we get a test for divisibility by 11, and at the same time the quotient after dividing out 11. The rule is to set the last digit under the next, and subtract, setting the remainder under the next, and so on. In this instance the test-number = 0; hence the given number = 11 × 5852053.

```
6 4 3 7 2 5 8 3
0 5 8 5 2 0 5 3
```

With periods of two digits, we get a test for divisibility by 101; and so for four or more digits. C. L. DODGSON.

Ch. Ch., Oxford.

P.S.—The sum of *all* the periods gives us, for periods of 1, 2, 3, &c., digits, a test for divisibility by 9, 99, 999 (= 27 × 37), &c., or for any factors of these numbers. This method may also be worked by a rule analogous to that given above; *e.g.*, to test for 999, mark off in periods of three, write 000 over the right-hand period, and subtract, writing the remainder over the next, and so on. Hence, also, if the test-number chanced to be zero, the upper line (omitting the 000) would be the quotient produced by dividing the given number by 999.

Probably similar rules may be made for most primes. I have myself made fairly simple rules for 17 and for 19; but such processes are rather curious than useful.

---

[1325]—Mr. Askew's rule is applicable not only, as he says, to the division 7 and 13, but also to 91. The reason is that both $(1000+1)$ and $(1000^2-1)$ happen to be exactly multiples of these three numbers.

Any number of over six figures may be expressed in the form

$$a + 1000b + 1000^2c + 1000^3d + \ldots\ldots \quad [A]$$

where the letters $a$, $b$, &c., stand for the numbers expressed by the successive triplets of figures, beginning at the right hand.

Now the quantity

$$(1000+1)b + (1000^2-1)c + (1000^3+1)d + \ldots\ldots \quad [B]$$

must be a multiple of 7, 13, and 91. If therefore the quantity [A] be divisible by one of these numbers, so also will the difference between [A] and [B]—viz, $a - b + c - d + \ldots\ldots$

HENRY BRADLEY.

[A number which is divisible by two prime numbers must necessarily be divisible by their product.—R.P.].

---

(Answer to Letter 1274, page 399.)

[1326]—"Point off the given number into periods of three figures. Add separately alternate periods, and find the difference of the sums thus obtained. If this difference is divisible by seven, the original number is so, and if not, not."

The reason is as follows:—Adding the figures alternately, and taking the difference, gives the criterion of divisibility by eleven, since the successive powers of ten (1, 10, 100, 1,000, &c.) divided by eleven give remainders 1, 10, 1, 10, &c.; similarly, adding them alternately in sets of two gives the criterion of divisibility by 101, since 1, 100, 10,000, 1,000,000, &c., divided by 101, give as remainders 1, 100, 1, 100, &c., and adding alternately in sets of three gives the criterion of divisibility by 1001, since 1, $10^3$, $10^6$, $10^9$, &c., give the remainders 1, $10^3$, 1, $10^3$, &c., when divided by 1001, and since 1001 is divisible by 7 and 13, the same method gives a criterion of divisibility for each of those numbers.

This is only a special case of the law of divisibility in any scale of notation—viz., that adding the figures gives the criterion of divisibility by one *less* than the radix of the scale, adding them alternately and finding the difference gives the criterion for one *more* than the radix. The radix in this case is 1,000. The number taken by Mr. Askew is 220,974,901.

```
220,000,000 = a multiple of 1,001 + 220
    974,000 =    "       "     - 974
        901 =    "       "     + 901
---------------------------------------
∴ 220,974,901 =  "       "     + 147
```

and since 1,001 is divisible by 7 and 147 is divisible by 7, a multiple of 1,001 + 147 is divible by 7. Also since 1,001 is divisible by 13 and 147 divided by 13 leaves remainder 4, a multiple of 1,001 + 147 must leave remainder 4. H. A. NESBITT.

---

## PROPERTY OF NUMBERS.

[1327]—The problem proposed in article No. 1295 of your issue of 6th inst. presents no great difficulty. The actual working-out, which is rather lengthy, I forward separately.

The result may be given as follows:—

Let $a$, $b$, $c$, and $d$ be the remainders when a number N is divided by 3, 5, 7, and 11 respectively.

Then $N = 1155r + 385a + 231b + 330c + 210d$.

The value of $r$ must be taken to suit the conditions of the problem, viz., N is to be a number of three digits.

If this problem is to be given as a mode of figure-conjuring, the conjurer will find the figures involved rather long for mental calculation. It would be better in that case to limit the problem thus:—

Tell a person to take any number not exceeding 100 (to say 105 might give a clue to the puzzle), to mentally divide the number by 3, by 5, and by 7, and to announce the remainders. The would-be conjurer should then be able to announce the number thought of in a few seconds.

The key to the conjuring is as follows—

$$N = 105r + 70a + 21b + 15c$$

$r$ being taken as zero or a negative quantity to suit conditions of problem. A. H. R. E.

P.S.—If another divisor, 13, be introduced and $e$ be the remainder, then it can similarly be found that

$$N = 15015r + 5005a + 6006b + 10725c + 1365d + \cdot 6930e.$$

---

## PROBLEM IN NUMBERS.

[1328]—The following problem was given by a Moor at Gibraltar to a friend of mine:—

Divide any number by 3, 5, and 7; the remainders are $a$, $b$, and $c$, and the number of 100 is $d$. With these data what is the number?

XUM

*Answer.*—$70a + 21b + 15c \pm n \times 105$, $n$ being such a number as will bring the result into the given number of 100.

*E.g.* 421.

Remainders.

3)421

$140 + 1 \times 70 = 70$

5)421

$84 + 1 \times 21 = 21$

7)421

$60 + 1 \times 15 = 15$

106

$+105 \times 3 = 315$

421

It may interest your readers to discover the rule and prove it. How the Moor discovered it may be an interesting subject to speculate on. G. H. BOLLAND.

## A SHEETED GHOST.

[1329]—I once saw a ghost—that is to say, as much of a ghost as I believe anyone ever saw (notwithstanding all one may read and hear) excepting, of course, nervous illusions. About the year 1861, when I was eighteen, and serving my articles, I was in bed with the window-blind up, and the moon shining into the room and on to my bed. I half awoke and, to my surprise, saw standing on me and reaching beyond the ceiling, a tall figure, like that of a man or woman draped in white. I continued to look at the figure, and then not feeling comfortable, resolved to ascertain what it all meant. At this time I was still only half awake, as only a few seconds had elapsed.

I raised myself, and lo! my ghost vanished. But not quite; for in a moment the optical illusion was apparent to me.

Just in front of and close to my eyes had been a pointed fold of the upper sheet of the bedclothes, and upon this the moon shone. In my half-awake condition the effect was perfect, and apparently the figure stood there in all its height; but when I moved I became more awake, and saw the ghost disappear into the pointed fold of the sheet. J. B. WILLIAMS.

## TRUE AND FALSE PERSPECTIVE.

[1330]—Neither "Ros. Vansittart" [1276] nor "An Old Draughtsman" [1288] appears to me to have touched the difficulty felt by "R. Jones" [1244], which is one that I (as a teacher of drawing) have found very puzzling to learners, especially to those who like to know exactly the "why and wherefore" of the rules they are taught. The fact is that the usual method, illustrated by "An Old Draughtsman," is a compromise between the impossibility of drawing a picture with a movable centre of vision and impractibility of drawing one on the inner surface of a sphere. The point of view for each picture must be rigidly fixed, and this necessitates the limiting of the field of view to a circle forming the base of a cone whose sides meet at the eye at an angle of not more than about 45° (some artists say not more than 30°). As soon as the eye is directed towards any other point than the centre of the base of this cone, the point to which it is directed becomes at once the centre of the base of a new cone, and a new picture must be drawn upon that point as centre. This is the difficulty experienced by "R. Jones," and over which so many students stumble. As long as the face of a cube is square to the direction of the observer's eye, it must be drawn square, although it may be on one side of the line of direction, for, as soon as he looks directly at it, he changes the position of the centre of vision, which then falls upon the cube itself, and the line of direction is no longer square to the same face of the cube.

The only exact way of representing objects as they actually appear to the eye is by drawing them on the inner surface of a hollow sphere to be viewed with the eye at the centre. This, of course, is impracticable, and indeed is unnecessary, as the same *effect* is got in the usual way if the visual angle is not made too large. Each picture may be then considered as a circular segment of a sphere of which the line of direction is a radius, and if the segment be taken small enough it will be so nearly a plane as to be represented on a flat surface without undue distortion, and *when viewed at the centre* will give the exact effect of the real object.

WM. FIELD.

## LETTERS RECEIVED AND SHORT ANSWERS.

JOHN A. R. NEWLANDS. You will find a short review of your book on page 370 of our fifth volume.—H. A. NESBITT. Letters by the Rev. C. L. Dodgson and another correspondent were marked for insertion a fortnight ago.—IGNORANT. Your question is more difficult to answer than it looks. I know of good books whence you may learn the various wild flowers, and cheap books having the same end; but none rigidly answering both descriptions. "Familiar Wild Flowers," published by Cassell & Co., and Ann Pratt's "Wild Flowers," published by the Society for Promoting Christian Knowledge come under the former category. Of the lower-priced works Bettany's "First Lessons in Practical Botany," published by MacMillan for a shilling, is as good as any.—GEORGE HILL wants to know how many feet of air can be compressed into an iron vessel one foot square? Obviously this must depend upon the strength of the vessel; 250 ft. if it is strong enough. Perhaps some aëronautical reader will answer your question, How long it takes to fill an ordinary balloon.—FREDERICK ELGAR. My personal experience with reference to strawberries differs widely from yours. I have eaten unnumbered gallons of them without developing either rheumatism or gout; albeit both my father and grandfather suffered from the last-named complaint. Should this meet the eye of Mr. Mattieu Williams he may, perhaps, give you the benefit of his opinion.—JOHN CHANNON. While persistently declining to advertise trade articles in the Health Exhibition now open at South Kensington, I willingly call attention to your exhibit of a Brick Finial in Class 50, representative as it is of the style and quality of instruction imparted at the Technical College, Finsbury, where all the *real* work of the City and Guilds of London Institute will be done in the future, as it has been in the past.—THE YNISCEDWYN COMPANY send me a pamphlet to prove that London might be rendered practically smokeless by the use of anthracite, as is the case in New York.—JOHN E. SYMS defends the usual method of drawing a cube against "R. Jones" and "C. E. Bell" (letters 1,244 and 1,307). Perhaps I may suggest that each of the disputants should place a cube behind, and with one face parallel to, a sheet of plate-glass, and, keeping the eye rigidly fixed (say by applying it to a pin-hole in a fixed card) trace the outline he sees accurately on the glass, and communicate the result in as short a form as possible. It will be time enough to theorise when we are agreed as to our facts.—A. L. M. sends an account of an odd coincidence. He is resident in the house of an old gentleman who is a keen flower-gardener. On the 19th ult., my correspondent was watching his landlord smarten up his beds, and after a little badinage, threatened to get up in the night and ride a donkey over them! As a matter of fact, a donkey did wander from its house that very night, get into the garden, and make an utter wreck of it; and on seeing its hoof-marks the next morning, the unfortunate proprietor of the ruined flowers could at first scarcely be convinced that his lodger had not carried his curiously improbable jocular threat into execution. "Now," says my correspondent, "I ask, suppose that I had threatened to kill him instead, and he had been found dead in the morning, could I have escaped hanging?"—A. P. SINNETT. Premising that reviews in this journal are not written by its editor unless specially signed by him, but are penned by contributors supposed to possess special knowledge of the subjects of the books to which they relate, I regret that the writer of the notice to which you take exception should have employed a phrase in the slightest degree calculated to hurt your feelings; but having myself read your book when it first appeared, I can only conceive that he said—with perhaps rather needless brusqueness—what every impartial reader of it must have thought. Your cutting from *Light* is not worth the paper it is printed on, inasmuch as the citation of many of the names it contains as those of Spiritualists is *dishonest*. Thackeray, for example, repudiated, both editorially and in his private capacity, the slightest belief in the cock-and-bull stories told by Robert Bell in Vol. II. of the *Cornhill Magazine* (vide Vol. VII. of that magazine, p. 706). Lord Brougham, again, publicly denied any belief in Spiritualism, and so on. Professor Hare was insane, and died, I believe, in an asylum. Nay, will you write to the very first man whose name heads your list, the Earl of Crawford and Balcarres, asking him whether he does or does not believe that so-called "Spiritual" phenomena are supernatural — and publish his reply? Mr. Crookes's "Phenomena of Spiritualism" lies on the table before me as I write. Finding, as I do, in it its author's testimony to the probity and the reality of the phenomena exhibited by Miss Florrie Cook (whom he took such elaborate pains *not* to find out), and knowing how this same Miss Cook's imposture was at once detected on Jan. 9, 1880, by Sir George Sitwell and Herr von Buch, what possible value can I attach to anything that Mr. Crookes may testify or say on the subject of spiritualism? It is idle to talk of "the frauds

sometimes perpetrated" by media. Can you give the name of one single well-known medium who has not been ultimately detected? I refuse to suffer the precious space in these columns to be wasted in connection with an imposture which can only be legitimately met by proceeding against media under 5th Geo. IV., c. 83, s. 4, and by placing their dupes in safe confinement.—MISS F. H. WOOD. I have received your historical chart, and your description of your new adjustable geometrical ruler with which it was executed. The latter seems an ingenious instrument, but as I have not the smallest idea when I shall be in town, I regret my inability to make an appointment to inspect it.—MISS MARGARET B. ALDER opines that if "the abysmal depths of the oceans were laid bare . . . . the red clay, with its incipient zeolites, feldspars, and iron oxides, and superfluous silica, would harden into basalt, granite, whinstone, trachyte, and other rocks said to be produced by former volcanic action"—in which I regret to differ from her.—CRAS. I know nothing about the books read for the London degree. The Hamiltonian system of interlinear translation will enable you to construe, but you will infallibly be tripped up in your examination if you do not study the grammatical structure of the sentences as well. — GEORGE CHAPMAN. Our satisfaction is mutual.—A. N. Professor Hughes was the real inventor of the microphone. I cannot spare the column which a description of its construction would occupy. So far as I know it has not been used by any maker of ear trumpets.—J. MURRAY. Send your communication to some other journal, with the offer of a handsome reward to any one who can make head or tail of it.—W. COMMON. Your "puzzle" is as old as the hills. Everything depends upon the direction in which you sail round the world. A ship going from west to east gains a day, on going from east to west loses one, so that if they started simultaneously on their respective voyages, and met again at their conclusion, it might be Tuesday on board of one ship and Thursday on the other. The difficulty is insuperable. There is no such a thing as a hora mundi.—C. E. MARRIOTT sends a letter to the Editor (for Mr. Pillinger) stating that he encloses fifteen stamps—which he does not—for a timepiece! My dear young friend, you must find out where Mr. P. lives, and write straight to him yourself. I am not his agent, and don't keep his timepieces here.—THE NATIONAL HEALTH SOCIETY sends me an excellent little tract on vaccination, which can hardly be too widely circulated.—SIR DANIEL COOPER and E. HOWELL. Thanks for cards of invitations, which overwhelming pre-occupation only has prevented me from accepting.—N. HOPKEN, AN OLD DRAUGHTSMAN, ROSALIE VANSITTART, and ARTHUR A. WEST. See reply to "John E. Syms," above.—W. W. S. It is utterly beyond the province of KNOWLEDGE to recommend individual tradesmen, but of the names you give the third is undoubtedly that of the most scientific artist.—A SUBSCRIBER asks for the composition of some transparent medium for the crystoleum process, which will not spot. Can any of our photographic readers oblige him?—R. RUSSELL. Neither the names nor addresses of correspondents can be given without their special permission.—GANGA RAM. Your pamphlet, when received, will be read by an expert in the matter to which it relates.—ERNEST (*sic*) ENQUIRER. As your facts are wrong, and your conclusions from them erroneous, I feel that I shall best comply with your request to "deal gently with" you by simply acknowledging the receipt of your letter.—W. CAVE THOMAS. Your original letter was already in type when the one you wished to be substituted for it arrived.—M. E. SIMPSON. Your communication shall be forwarded to the proper quarter. —J. The subject is being treated of from a *scientific* point of view, and from that alone; but science is dumb in the presence of such considerations as those which you advance.—T. COMMON. It seems probable, as you say, that Mr. A. McD. has misunderstood the passage you quote. I entirely agree with you that "Mr. Garbett would probably get as much information with regard to the flood from the 'Homo diluvii testis' among the Salamanders in the British Museum as from Mount Ararat and Noah's rainbow." —WATSON & SONS. Received.

---

THE eighteen principal English railways have earned almost exactly a million a week for the twenty-four weeks of the present year.

A SHIP STRUCK BY LIGHTNING.—A despatch from Derry, dated 22nd ult., says:—"Captain M'Cann, master of the Derry barque *Village Bell*, arrived in port this evening from Baltimore. He reports having eight sailors on board belonging to the Spanish ship *Angeleta*, from New Orleans to Barcelona, which was struck by lightning and set on fire." The message states that the whole of the crew were rescued, and makes no mention of any casualty amongst them. The ship appears to have been burnt to the water's edge.

## Our Paradox Column.

THE foolish fellow who mischievously threatened a universal storm some time since, publishes the following curious illustration of paradoxical absurdity. We give it, heading and all, as it appeared in the *New York Tribune*:—

*WIGGINS'S DARK MOON.*

IS THE EARTH ACCOMPANIED BY TWO SATELLITES?

THE CANADIAN WEATHER-SEER SAYS IT IS AND TELLS THE REASON WHY.

*To the Editor of the Tribune.*

SIR,—For many years it has been my belief that our planet is accompanied by two satellites, a visible and a dark one, the distance of the latter from the earth being probably double that of the former. The librations of the moon, the irregularity of her motions in her orbit, and the fact that her perigee seldom takes place immediately on the orbit of our earth in advance of the earth's course, are strong evidence of the disturbing influence of a sister satellite. The variation in the time and height of the tides, occasional tides of excessive height without apparent cause, and the frequent occurrence of double tides, cannot be explained on the hypothesis that the earth is attended by only one secondary. Earthquakes which are caused by unusual planetary attraction frequently occur when it would appear that the force which produced them had not yet reached its climax, and could not till after the moon's conjunction with the sun. The recent earthquake in England occurred two days before the moon was in conjunction with the solar orb, and before she was in perigee, showing that her attractive power must have joined with another and very nearly equal force before she reached the line of her solar conjunction. This earthquake I predicted would return with increased violence on May 20. It did so, causing the destruction of many villages and the death of hundreds of people. On the same day occurred the disastrous cyclone in British Burmah. The earthquake, however, did not appear in England, and I am convinced it was moved eastward by the influence of this dark planet. The recent cold wave which passed over America must have been due to this source, and as nearly the same conditions will exist on the 26th and 27th of the present month, the same cold wave would appear were it not for the changed position of this dark horse of the heavens.

All great storms should occur after certain planetary conjunctions, whereas they frequently precede them, and it is for this reason that many meteorologists—among them Sir William Thompson (*sic*)—have denied that the moon has any influence whatever in producing storms on the surface of our globe. Years before I published predictions I found that some of my storms would be delayed for several days, others would appear ahead of time, and frequently the heaviest would be annihilated altogether. There were no known planets which could possibly produce this effect, and I was at length forced to the conclusion, as I have said, that our earth is accompanied by a dark satellite. It would further appear that the "dark days" of which frequent mention is made in history—so called because they could not be traced to an ordinary solar eclipse—were of such a character as to justify the belief that they were caused by an opaque body intervening between our globe and the sun, for the suddenness and brevity of the darkness could not be interpreted as due to smoke or vapour in the earth's atmosphere.

I am confident that the moon and this dark satellite were in conjunction with the sun, or nearly so on March 9, 1883, which produced the eruption of the great Java volcano, and caused the storm which I predicted would be—and the London *Times* says it was the greatest storm of the present century. On March 26, 1884, this planet was somewhere in the neighbourhood of her inferior or superior conjunction, and heightened the storm of the 28th of that month. Strange to add, I have just received letters from Michigan saying that a solar eclipse was visible in that State on May 16, 1884, at 7 o'clock in the evening, when fully one-third of the solar disc was in darkness. As the moon at that moment was twelve degrees south of the celestial equator, and the sun was as many degrees north of it, this phenomenon could not have been caused by our visible satellite. Doubtless it was the passing of this dark planet across the sun's disc.

I have little sympathy with Professor Proctor and others, who, with the prejudice of the old schoolmen, persist in declaring that our moon is a dead planet, and is not possessed of an atmosphere. Any one who will take the trouble to look when she is in quadrature, will see with the naked eye on a clear night the whole luminous

XUM

annulus or ring of light that surrounds her orb, which is proof positive and complete that she is enveloped in an atmosphere similar to our own. The same arguments were used long ago by Dr. Dick and others to prove that Jupiter and other primaries are destitute of an atmosphere, while the very fact that they are visible, is evidence that they are endowed with atmospheres like that of our own globe, for surely no one is now antiquated enough to believe that light exists throughout space but only in the atmosphere of the planets. The non-existence of a second satellite to the earth is therefore not proved by reason of its invisibility. Its position can only be ascertained by noticing the sudden quenching of stars, and I trust that astronomers both in America and Europe will aid in obtaining the magnitude and motions of this lonely wanderer in the sideral heavens. E. STONE WIGGINS.

Ottawa, June 3, 1884.

To all which nonsense the *New York Tribune* is at the pains somewhat gravely to reply. The closing words of the leader devoted to this precious rubbish are neat however:—"Unfortunately," says the *Tribune*, "there is one view of Mr. Wiggins's discovery which he has failed to take, to wit, the view that it may not be at all necessary. For between accepting a dark moon (save as an exercise of pure faith) and believing that the meteorological theories of Mr. Wiggins are nonsensical, the great majority of mankind will, we fear, be very apt to find the second conclusion the easier and simpler of the two."

---

THERE is a series of illustrated notes on the Pons-Brooks Comet of 1883, by H. C. Wilson, in the *Sidereal Messenger* for June, which students of cometary physics will read with interest.

MANGANESE IN ANIMALS AND PLANTS.—Recent researches by M. Maumené have, says *Engineering*, shown that the metal manganese exists in wheat, rice, and a great variety of vegetables. Wheat contains from $\frac{1}{10000}$ to $\frac{1}{15000}$ of its weight of the metal, which exists chiefly as a salt of an organic acid. It is also found in potatoes, beetroot, carrots, beans, peas, asparagus, apples, grapes, and so on. The leaves of the young vine are very rich in it; so are the stones of apricots. The proportion in cacao is very great, as it is in coffee, tobacco, and especially in tea. In the 50 grammes of ashes left by a kilogramme of tea, there was found 5 grammes of metallic manganese. There are vegetables, however, in which no manganese can be found, as, for example, oranges, lemons, onions, &c. Many medicinal plants contain it, as for example, cinchona, white mustard, and the lichen (*Roccella tinctoria*). Animal blood does not always contain it, but it is found in milk, bones, and even hair. M. Maumené regards its presence in the human body as an accident, and not of vital importance. He also suggests that doctors should cease to employ manganese as a succedaneum with iron, for while the latter is useful to the blood, the former is an intruder which is only tolerated in small traces, and rejected in larger quantities. Tea, coffee, and other vegetables require abundance of manganese in the soil for their proper cultivation, and the absence of it may account for the failure of many plantations.

IN connection with the series of lectures now and for some time past in course of delivery by some of our best-known scientific men, at the Royal Victoria Coffee Hall, a lecture was given on Tuesday week by Mr. Arthur Nicols, F.G.S., F.R.G.S., on "The Dog as the Friend of Man," illustrated by numerous large coloured pictures of the heads of the principal breeds, prepared specially from drawings by distinguished artists. The lecturer treated his subject from the point of view of the lover of dogs, rather than of the dog-fancier. He first gave a sketch of the origin of domestic dogs, which all competent naturalists are now agreed in considering as having been derived from some three or four wild species; and proceeded to consider in detail the senses—sight, hearing, and smell—by instances mainly derived from his own experiences at home and abroad, giving many illustrative examples and anecdotes of the utility of dogs. In more than one instance the lecturer showed how his life had been saved by the viligance of these faithful animals. He next described the characteristics of the principal breeds, commented on dog-shows, canine madness, &c., and gave instances in evidence of the intellect and moral character of dogs, concluding with remarks on the influence which association with the dog has exerted on man himself. The lecture was listened to throughout with great attention by a very considerable proportion of the audience, the conduct of the occupants of the gallery, however, leaving much to be desired. A hand-bill was previously distributed in the hall of notes, drawn up by Mr. Nicols, on "Mad Dogs: How to Know Them, and What to Do," with the object of diffusing useful information on this important subject.

# Our Mathematical Column.

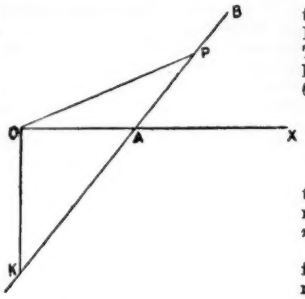
## EASY LESSONS IN CO-ORDINATE GEOMETRY.

BY RICHARD A. PROCTOR.

(*Continued from p. 467.*)

POLAR CO-ORDINATES.

45. PROP.—*To find the polar equation to a straight line in terms of the angle at which it is inclined to the initial line, and the intercept on the initial line.*




Let A B be a line meeting the initial line O X in A. Let $OA=a$, and $\angle BAX=\alpha$. Take P any point on A B, and let the co-ordinates of P be $r$, $\theta$. Join O P, then

$$OP=OA\,\frac{\sin OAP}{\sin OPA}$$

that is $r=a\,\dfrac{\sin\alpha}{\sin(\alpha-\theta)}$

the required equation, which may be written in the form

$$r\sin(\theta-\alpha)+a\sin\alpha=0 \qquad (1.)$$

We might have obtained (1) from the equation to A B in rectangular co-ordinates (O X the axis of X). For draw O K perpendicular to O X to meet A B in K, then $OK=a\tan\alpha$. Thus the equation to B K is

$$\frac{x}{a}-\frac{y}{a\tan\alpha}=1$$

that is, since $x=r\cos\theta$, and $y=r\sin\theta$

$$\frac{r\cos\theta}{a}-\frac{r\sin\theta\cos\alpha}{a\sin\alpha}-1=0$$

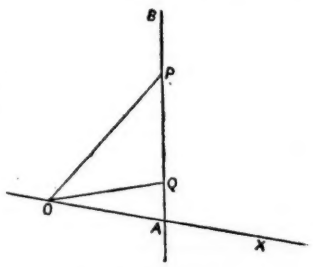
or

$$r\sin(\theta-\alpha)+a\sin\alpha=0 \qquad (1)$$

as before.

We can obtain the polar equation in a more convenient form by determining the line in a different manner.

47. PROP.—*To find the polar equation to a line in terms of the perpendicular on the line, and the angle at which this perpendicular is inclined to the initial line.*




Let A B be a straight line. Draw O Q perpendicular to A P, and suppose $OQ=p$ and $\angle QOA=\alpha$; let $r$, $\theta$ be the co-ordinates of any point P in A B; then

$$OP\cos POQ=OQ$$

that is

$$r\cos(\theta-\alpha)=p$$

the required equation.

47. If in (1) $\alpha=0$, the equation becomes

$$r\sin(\theta-\alpha)=0$$

*ie.*, $\sin(\theta-\alpha)=0$

Hence $\theta=\alpha$ or else $\theta-\alpha=\pi$; that is $\theta=\alpha$ or $\alpha+\pi$; and it is obvious that either form expresses the same line. Hence the equation to a line through the pole inclined at an angle $\alpha$ to the initial line is

$$\theta=\alpha.$$

48. And, *vice versâ*, an equation of the form $\theta=$ a constant, represents a straight line through the pole; for it is clear that such a line is the only curve for every point of which $\theta$ is constant.

49. The polar equation of the straight line is of the form

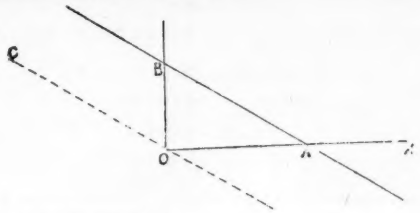
$$Ar\cos\theta+Br\sin\theta+C=0 \qquad (1)$$

and we might easily prove, conversely, by an independent process that an equation of this form always represents a straight line. This is not necessary, however, since transforming to rectangular co-ordinates making the pole the origin and the initial line the axis of $x$, (1) becomes

$$Ax+By+C=0$$

an equation which, as we have already seen, represents a straight line whose intercept on the axis of $x$ (that is, on the initial line of our polar equation) is $-\dfrac{C}{B}$, and which is inclined to the same axis or initial line at an angle whose tangent is $-\dfrac{B}{A}$.

50. The following examples illustrate the method of drawing the lines represented by given polar equations.




Take first the equation

$$2r\cos\theta+3r\sin\theta-6=0 \qquad \text{(i)}$$

Put $\theta=0$, giving $2r-6=0$

That is $r=3$

Again put $\theta=\frac{\pi}{2}$, giving $3r-6=0$

That is $r=2$

Thus the given equation represents the line A B in the figure, in which O A = 3, and O B = 2, O B being drawn at right angles to the initial line O X.

51. The following method is often more conveniently applicable.

In (i) put as before $\theta=0$, giving $r=3$; that is, determining the point A in which the given line cuts the initial line. Now since

$$r=\frac{-6}{2\cos\theta+3\sin\theta}$$

it is clear that if such a value be given to $\theta$ that

$$2\cos\theta+3\sin\theta=0.$$

In other words, if we take

$$\tan\theta=-\frac{2}{3}$$

$r$ becomes infinitely great. Hence if O C be drawn from O inclined to O X at an angle whose trigonometrical tangent $=-\frac{2}{3}$, then O C must be parallel to the line represented by (i). Thus we must take O A = 3 and then draw through A the line D A B parallel to O C.

Take as another illustration the equation

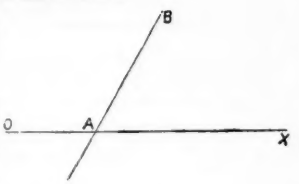
$$5r\cos\theta-2r\sin\theta-10=0$$

Here $\theta=0$ gives $r=2$, and to make $r$ infinite we must take

$$5\cos\theta-2\sin\theta=0$$

that is, $\tan\theta=\frac{5}{2}$

Thus if we take O A = 2 and draw A B inclined to O X at an angle B A X whose tangent is $\frac{5}{2}$, A B is the line represented by the given equation.




*(To be continued.)*

## EASY RIDERS ON EUCLID'S FIRST BOOK.

### WITH SUGGESTIONS.

### PROP. 33.

142. Two straight lines A B and A C are drawn from a point A; and two other straight lines D E and D F from a point D. A B is equal and parallel to D E, and A C is equal and parallel to D F. Show that B E is equal and parallel to C F.

143. If a quadrilateral have two of its sides parallel, and the other two equal but not parallel, any two of its opposite angles are equal to two right angles.

144. Two equal but not parallel lines make equal angles on the same side of a third line which joins their extremities. Show that the straight line which joins their other extremities shall make equal angles with the two first lines and be parallel to the third.

145. In the figure to Euc. I. 5, G L drawn perpendicular as to B C produced, is produced to M so that L M is equal to L G. Show that B L is equal and parallel to F C.

### PROP. 34.

146. The diagonals of a parallelogram bisect each other.

147. If two straight lines bisect each other, the straight lines joining their extremities form a parallelogram.

148. No two straight lines drawn from the extremity of the base of a triangle to the opposite sides can possibly bisect each other.

*(To be continued.)*

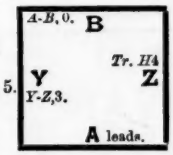
# Our Whist Column.

BY FIVE OF CLUBS.

### THE HANDS.

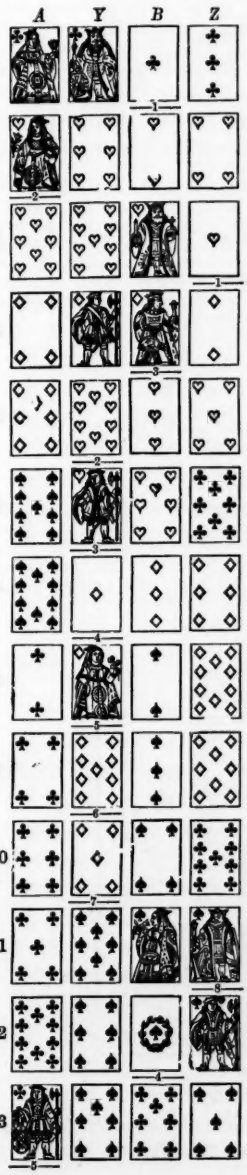
B { H. K, 7, 3, 2. / C. A, 7. } S. A, Q, 4, 3, 2. / D. K, 3.

Y { H. Kn, 10, 9, 6. / C. K. / D. A, Q, Kn, 9, 5. / S. 8, 7, 6. }




Z { 4, 5, A. H. / 3, 8, 9. C. / 2, 6, 8, 10. D. / 5, Kn, K. S. }

A { H. Q, 8. / C. Q, Kn, 10, 6, 5, 4, 2. } S. 10, 9. / D. 7, 4.




### THE GAME.

1. *A* leads from his long suit, and properly leads Queen from Q, Kn, 10, &c. The suit is established first round.

2. *B* seeing his partner's suit cleared (of course it is not known to *B* that *A*'s suit is *established*), and having commanding strength in Spades and a King guarded in Diamonds, properly leads trumps.

3. After this round *Y* remains with command in trumps; *B* cannot hold more than two, or he would have led Heart three originally—*the penultimate*.

4. *Z* properly leads from length rather than from strength.

5. *A* properly discards from his weakest suit.

6. *Y* clears out trumps before leading from his long suit.

7. So far as this round shows, *Y* may not have length and strength in the suit originally led by *Z*, but may be simply playing to clear *Z*'s suit.

8. *B* renouncing shows *Z* how the Diamonds lie. *Y* holds Queen, nine, and five. If *Z* plays the lowest he will have to take the next round in Diamonds, and either to lead *A*'s established suit or the suit in which *B* is presumably strong. But playing out the ten, *Z* clears his partner's Diamonds, gaining one trick in that suit.

9. *B* plays very badly here. The other three tricks are in *A B*'s hands, and all wanted if game is to be saved. But the weakness so many players have for making tricks themselves rather than let their partner make them, causes *B* to finesse the Queen, instead of taking the trick with the Ace and leading Club to his partner's commanding sequence.

---

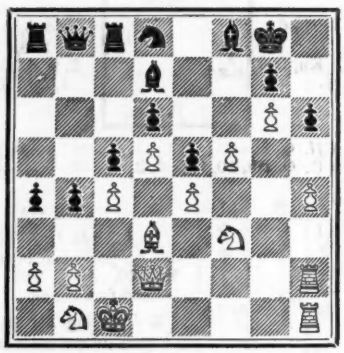
The above hand is from Cavendish (Notes by Five of Clubs). It illustrates a point which inexperienced players constantly overlook,—the necessity of getting rid of command of partner's suit when that suit has been established and can be brought in.

# Our Chess Column.

BY MEPHISTO.

THE following remarkable position occurred in the game between Messrs. Hirsch and Blackburn, the latter player yielding Pawn and move to his opponent, in the Handicap Tournament now in progress at the Divan.

MR. BLACKBURN.
BLACK.



WHITE.
MR. HIRSCH.

White has a very strong game, and, with a few well-directed moves, he ought soon to obtain a winning advantage. Amongst other moves he may play Kt to Kt5 as the P dare not take, to be followed by Kt to R7, and P to B 6 &c. Black is almost powerless, and could not have offered much resistance. In this position White played the most remarkable move of

Q to Kt5.

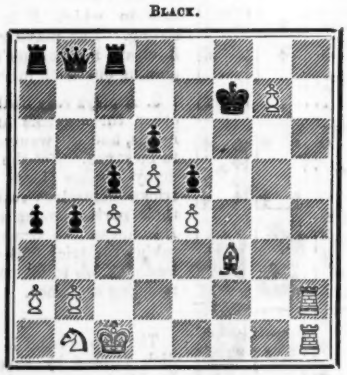
and the game continued as follows:—

| | |
|---|---|
| | P × Q |
| P × P | Kt to B2 |
| P to B6 | B to Kt5 |
| B to K2 (threatening to win by Kt × P). | |
| | B × Kt |
| B × B | P × P |
| P × P | B to Kt 2. |

Here White missed the right reply, and thus failed to reap the benefit of his brilliant play. White played P × B, to which Black replied with Kt to Kt4, and ultimately won the game. We think, however, that the issue would have been different had Black followed the obvious line of play and taken the two pieces; in which case the following might have occurred:—

| | |
|---|---|
| P × Kt (ch) | K × P |
| P × B | |

MR. BLACKBURN.
BLACK.



WHITE.
MR. HIRSCH.

Now we really do not see a satisfactory continuation for Black. Our informant, Mr. Frankenstein, is of opinion that White ought to win. We give a few possible variations, leaving to our readers to determine whether Black had any valid defence. If, for example:—

| | | | |
|---|---|---|---|
| K takes P | | R to Kt sq | |
| R to Kt sq (ch) | | B to R5 (ch) | |
| K to B3 | K to B sq | K takes P | K to K2! |
| R to R6 (ch) | R to R8 (ch) | R to Kt sq (ch) | R to Kt sq |
| K to K2 | K to K2 | K moves | K to Q2 |
| R to R7 (ch) | R to R7 (ch) | R to B2 (ch) | B to B7 |
| K to B sq | K to B sq (*b*) | K to K2 | Q to Kt3 (*c*) |
| B to K4 | | R to B7 (ch) | R to B2 (*d*) |
| and wins (*a*). | | and wins. | |

(*a*) Black has no satisfactory move, as White threatens B to K6, if Black now plays R to Ksq, then B to R5, R to K2. R to R8 (ch) and wins, or, if instead of R to Ksq, Black plays R to B2, White ought to win by winning the Queen by R to R8 (ch), and remaining with two minor pieces against a Rook. This, we think, is the best result that Black may hope to attain.

(*b*) And the position is the same as before. If, instead of K to Bsq, Black now plays K to B3, then B to R5 wins.

(*c*) Instead of this, Black may play R takes P. R takes R, K to B2. B to K6(ch), K to Kt3. R to R7, Q to Qsq. Kt to Q2, Q to B3. B to B4, and White must win by bringing his Kt well into play. The black Rook dare not move, and if either P advances, White pushes on.

(*d*) Again, it is difficult to see what to do for Black, as White threatens either B takes R, followed by R to B8 or B to K6, followed by R to B7. If now Q to Qsq, B to K6(ch), K to B2. R to B7(ch), K to Kt3. R to Q7, Q to B3. Kt to Q2 (threatening R to Bsq, followed by R takes P(ch) &c.), Q to R3, R takes P(ch), K to Kt2. R to Q7(ch), followed by B to B5, and White ought to win.

We do not presume to have exhausted Black's chances of defence, at almost every move a variation of play may occur; the above analysis is only intended to serve as a general indication of what might be attempted in this remarkable position.

## SOLUTION OF PROBLEM, p. 467.

1. R to Kt3, and mates accordingly.

## ANSWERS TO CORRESPONDENTS.

*** *Please address Chess Editor.*

Correct solutions received of A. W. Overton—George Gouge—Q. T. V.

Senex wishes to find an opponent for correspondence games.

E. Ridgeway.—If 1. B to K6, Kt takes P, and there is no mate. This problem has deceived a good many solvers.

## CONTENTS OF No. 139.


| | PAGE |
|---|---|
| Dreams. III. By Edward Clodd. | 469 |
| Notes on Flying and Flying Machines. By R. A. Proctor | 470 |
| Pleasant Hours with the Microscope. (*Illus.*) By H. J. Slack. | 472 |
| Electric Projectors on Yachts | 473 |
| The Entomology of a Pond. (*Illus.*) By E. A. Butler | 474 |
| Sea-Clouds. By Richard Jefferies. | 475 |
| The International Health Exhibition. V. (*Illus.*) | 476 |
| Dickens's Story Left Half Told. By Thomas Foster | 478 |
| Zodiacal Maps for the Month. By R. A. Proctor | 480 |
| Optical Recreations. (*Illus.*) By F.R.A.S. | 480 |
| Reviews: The Sagacity and Morality of Planets—Some Books on Our Table | 482 |
| Correspondence: The Noachim Deluge — Coincidences — The Divided Skirt—Brain Weights,&c. | 483 |
| Our Mathematical Column | 488 |
| Our Whist Column | 489 |
| Our Chess Column | 490 |



## *SPECIAL NOTICE.*

Part XXXII. (June, 1884), now ready, price 1s., post-free, 1s. 3d.

Volume V., comprising the numbers published from January to June, 1884, will soon be ready, price 9s., including parcels postage, 9s. 6d.

Binding Cases for all the Volumes published are to be had, price 2s. each; including parcel postage, 2s. 3d.

Subscribers' numbers bound (including title, index, and case) for 3s. each Volume; including return journey per parcels post, 3s. 6d.

Remittances should in every case accompany parcels for binding.

## *TERMS OF SUBSCRIPTION.*

The terms of Annual Subscription to the weekly numbers of KNOWLEDGE are as follows:—

| | s. | d. |
|---|---|---|
| To any address in the United Kingdom | 15 | 2 |
| To the Continent, Australia, New Zealand, South Africa, & Canada | 17 | 4 |
| To the United States of America | $4.25 or 17 | 4 |
| To the East Indies, China, &c (*vid* Brindisi) | 19 | 6 |

All subscriptions are payable in advance.

OFFICE: 74-76, GREAT QUEEN STREET, LONDON, W.C.